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M. BAZIN'S ROLLER STEAMSHIP.

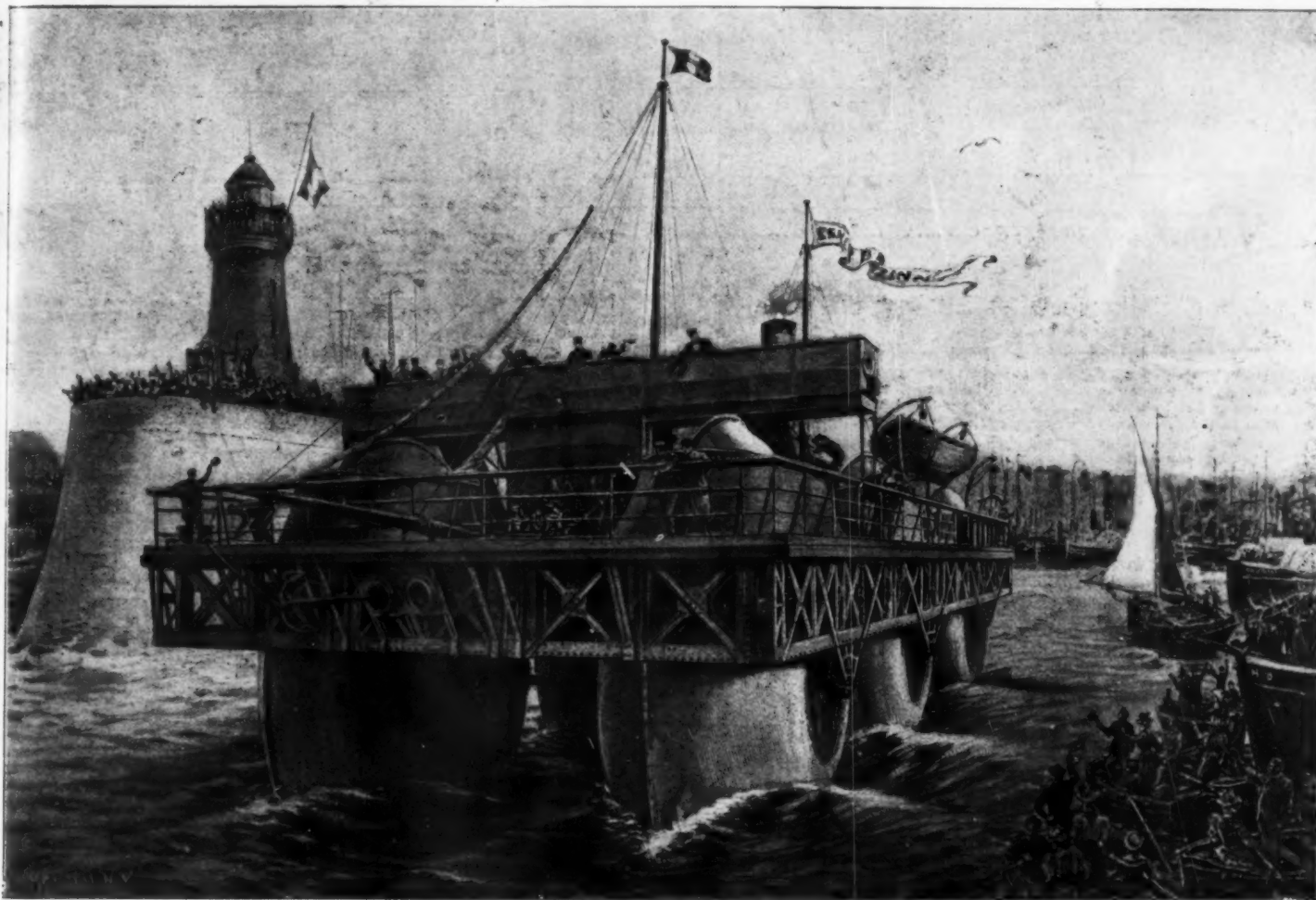
No invention involving so radical a change in the construction of steamships has been put before the public since the first steamers were produced at the beginning of the century as the "roller" steamship of M. Bazin, the French engineer. Hitherto, the hull of a ship has been built more or less egg shaped, but the Ernest Bazin consists of a flat rectangular deck supported upon twelve disks or wheels. The vessel, which was launched last year, is only an experiment, so to speak, and is therefore small, being only of 274 tons burden. M. Bazin hopes in time to build a steamer large enough to cross the Atlantic. Meanwhile, he has been trying the experimental steamer. The Ernest Bazin has six floats or wheels; her length is 131 meters, and breadth 39 meters. On the deck are the cabins, saloons, machinery and boilers. The whole idea pursued in

Sir Edward J. Reed, who went to ascertain from personal observation how the vessel behaved, and more especially in what degree the speed would be affected by applying part of the available steam power to the rotation of the rollers instead of to the direct propulsion of the vessel.

Sir Edward Reed's report to the Société d'Etudes et d'Exploitation des Navires Rouleurs Bazin has just been issued. The vessel's engines are of 350 I. H. P., and these engines work both the screw machinery and the rollers jointly; so that in this vessel of 274 tons displacement there was only about one-seventeenth of the steam power requisite to drive a vessel of similar size at thirty knots, and one-twelfth of that necessary to drive her twenty-seven knots. Nothing but a very low speed could, therefore, be anticipated of the vessel, owing first to her smallness, and secondly to her low steam power. A small vessel is, in Sir Edward Reed's opin-

stead of being applied to the rollers, and I find that by this means we should merely have added 0.55 of a knot, thus raising the speed from 4.25 to 4.8 knots only.

In the next experiment the power exerted upon the screw was increased to 295 I. H. P. and the roller power to 34.2 I. H. P., the rollers revolving nine turns per minute. I calculate that with the rollers at rest, the increase of horse power upon the screw should have raised the speed from 4.25 to 5.8 knots. The actual speed attained was 6.81 knots, giving an excess of speed due to the revolution of the rollers of 1 knot. It will be seen that this gain is not quite so much as in the previous case, although the power applied to the rollers was somewhat increased—a fact that may be conjecturally accounted for in several ways; but there remains the remarkable fact that the vessel steaming at say 5.8 knots only, with 295 I. H. P. applied to her screw, is increased in speed by fully a knot by the application of



THE ROLLER STEAMER ERNEST BAZIN LEAVING HAVRE ON A TRIAL TRIP.

the construction of the vessel has been the reduction of friction with a consequent increase of speed at a minimum of expense and effort, by rolling through the water instead of cutting through it. Each of the rollers has a displacement of about 45 or 46 tons. The rollers serve, it will be seen, not only as part of the means of propulsion, but also take the place of the hull in an ordinary vessel. The Transatlantic liner which M. Bazin proposes to build is to have four of these wheels instead of three as in the experimental steamer. The shafts for making the wheels revolve pass below and across the platform, and, like the wheels, are of steel. M. Bazin argues that in order to obtain a maximum rate of speed there must be a corresponding relation between the rotary force and the propelling force, and his steamer is fitted with two independent sets of engines, one to drive the rollers and the other to propel the vessel forward by means of a screw. Among other advantages claimed for the vessel may be mentioned the small amount of rolling and the ease with which repairs to the hull can be attended to, docking being unnecessary. Then again it is urged that if a wheel is damaged the injury can be made good without stopping the vessel, for the injured wheel and its corresponding wheel on the other side can be stopped while repairs are done, while the others can continue their course through the water. On July 20 the Ernest Bazin went on a trial trip from Havre. On board her was

ion, very unsuited to the application of the Bazin system. The rollers are of necessity too close to each other, and consequently the systems of waves which the onward movement of the rollers creates and sends off on each side of each roller very soon reach each other and cause reactionary turmoil, which is unfavorable to smooth and easy progress, whereas in a much larger ship the progress would be much less interfered with by this cause. Then, too, so small a vessel is necessarily shallow, and no proper immersion can, under ordinary conditions, be given to the screw propeller, and a screw propeller works at a very great disadvantage when too near the surface. However, in spite of the disadvantages under which the system was tried, the vessel surprised Sir Edward Reed by its performance, and he gives the following results of the experiments made on the trip:

"We began the trials off Havre with very small power and speed. In the first two measured runs only about 112 I. H. P. was exerted by the screw propeller engines, giving, with the rollers at rest, a speed of 4.25 knots. Keeping only the same propelling power at work, but causing the rollers to revolve seven turns a minute by the application of 25.68 I. H. P., we obtained a very remarkable increase of speed, which rose to over 6 knots (more exactly 6.09 knots). I have calculated what the increase of speed would have been had this 25.68 I. H. P. been added to the screw engines in-

only one-ninth of that power to her rollers! A further, but small, increase of speed (from 6.81 to 6.97 knots) was obtained by increasing the power on the rollers to 52.2 I. H. P. Small as this increase was, it nevertheless points to the fact that the additional 18 I. H. P. was much more efficient when applied to the rollers than it would have been if applied to the screw propeller."

In conclusion, Sir Edward Reed says:

"There can be no doubt whatever that the experiments conclusively demonstrated that the Bazin rollers furnish an effectual means of greatly reducing the friction which a floating body encounters in its advance through the sea, and friction is certainly one of the most serious of the elements which compose the resistances encountered. It does not, of course, remove or evade all friction, for all the ascending and descending parts must of course encounter some friction even in still water; as must also those immersed parts of the roller which are not retreating, so to speak, or moving sternward, with precisely the same velocity as the ship advances; but, as regards these latter, it must be remembered that all are moving sternward at some velocity, and therefore all are avoiding, to some extent, the resistance due to friction. It has been conclusively shown, I think, that on this question of reduced friction and consequent increase of speed or decrease of power, M. Bazin's views have been in a general sense fully established."

The reports of a number of pilots who have had charge of the vessel on various occasions go to show that she behaves well in a fresh breeze and rough sea, and that she is an exceptionally dry boat and easily handled. We are indebted to the London Graphic for the engravings and particulars.

PNEUMATIC LOCKS FOR CANALS.*

By CHAUNCEY N. DUTTON, New York.

THE first canal lock was built about 1490 by Leonardo da Vinci to relieve the commerce of Milan. He had not cheap steel, therefore could not use materials in tension. A good mechanic and engineer, understanding perfectly the qualities of masonry and timber, the ancient materials of construction, he used them so skillfully that his work could not be improved until modern progress gave us steam power and cheap steel and made possible structures depending on tensile strength. Engineers have attempted substitutes for Leonardo's lock, but with very moderate success. Edwin Clark, of England, built balanced hydraulic lifts, suitable for small single boats, where the foundation could be rock, and the German government has recently built a lock operated by four huge screws at the corners, assisted by a float. But locks of these types are inherently defective and involve the risk of dislocating the transportation system and the exchange of commodities, which in our modern civilization would cause business paralysis, ruin and starvation.

These attempted structures have required delicate manipulation, exact regulation of the canal levels, and

Third: Absolute immunity from falling. The pneumatic lock falls up, if it falls at all. It is pressed up firmly against the anchors with an effort much greater than the weight of the lock and its load. If the anchors yield, the lock is forced up to a height such that the air in the air chamber is expanded to equilibrium with the load, and a volume of water equal in weight to the difference between the load and its initial excess of buoyancy has entered the air chamber.

Fourth: Water trap valve for controlling the air conduit.

Fifth: The powerful automatic leveling or synchronizing shafts, of construction cheap, and such that the price per pound does not increase with increased power.

Sixth: Dispensing with the dry dock and operating the lock directly in the lower level of the canal in a pit, the pit in which the lock works being part of the lower level.

Seventh: The substitution of steel, mainly in tension, for masonry. A thin steel plate will do more work than the heavy masonry walls of the Leonardo locks. In most situations the pneumatic lock requires masonry only to support the guides and as weights for the anchorages.

Eighth: Substitution of elastic resistance for mere stability due to dead weight, which reduces the strains due to shocks so that they can be taken care of economically.

The principal elements are:

1. The locks, which are identical structures, in balance, each having a lower open-bottomed air chamber on which it floats and an upper gated lock chamber,

There is an interlocking apparatus or sequence machine which prevents doing the wrong thing at the right time while working the locks and a governor which keeps the locks from running away and stops them at the right elevation.

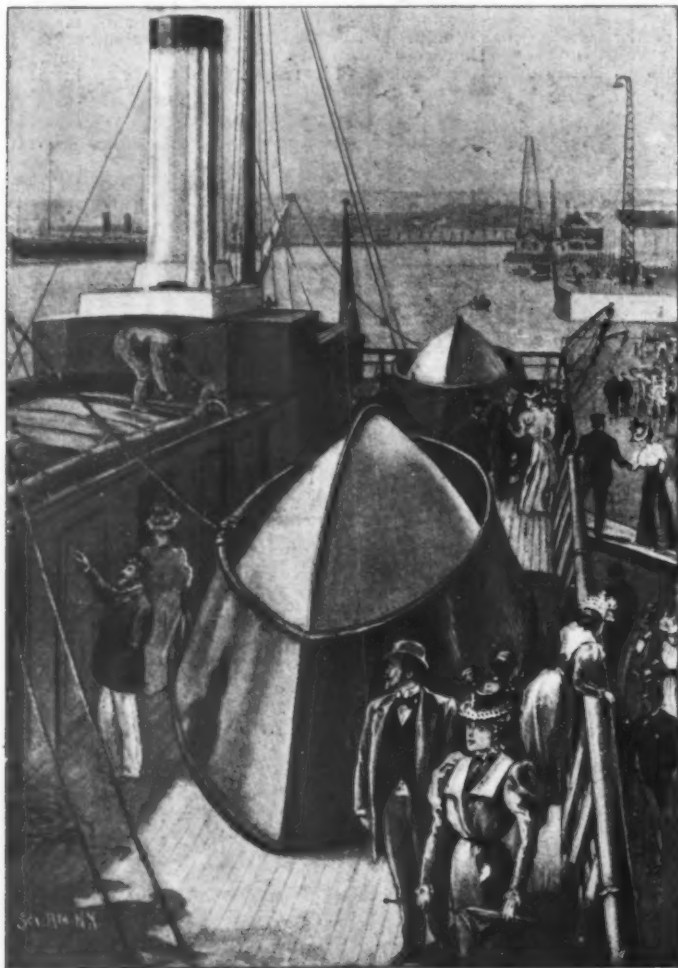
It is obviously impossible to exactly balance any load, especially a variable load, upon an unstable medium such as air. It was, therefore, necessary to do one of two things; either

a, to make the lock deficient in buoyancy and provide a rigid auxiliary support, or

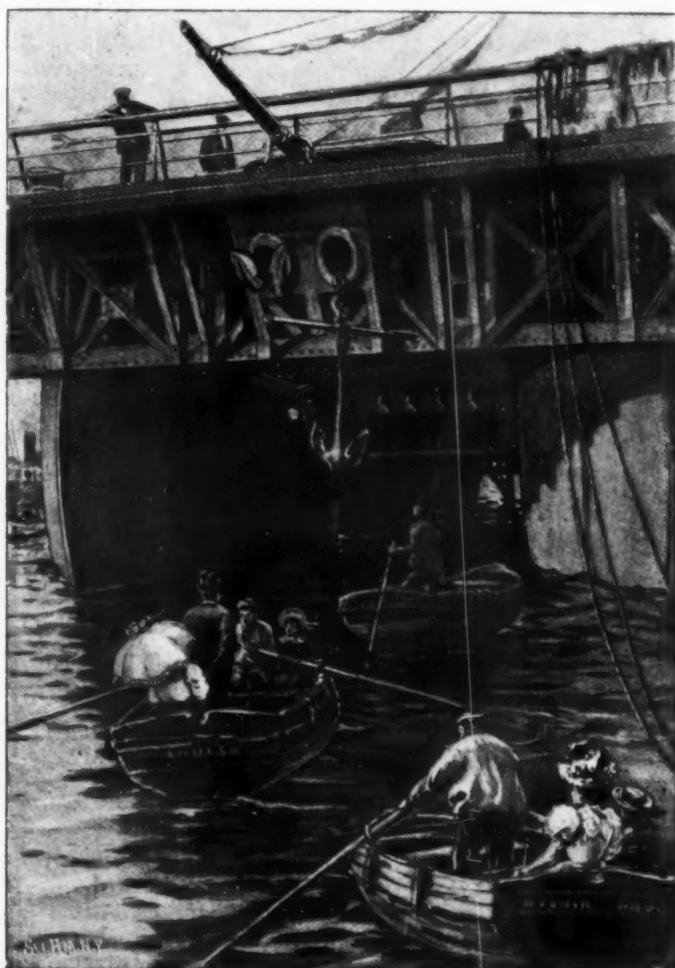
b, to make the lock superbuoyant and restrain it from rising too high by the engagement of the lock structure with anchors.

The latter was adopted after many designs of the first type had been considered and found defective. The elevated lock is firmly held and thrust upward against the anchors, which restrain it, with a surplus buoyancy or lift exceeding any possible variation in load or buoyancy. The air pressure in the elevated lock is great enough to expel from the air chamber a weight of water 25 to 30 per cent. greater than the weight of the loaded lock, the upward strain being held by anchors before referred to. This constant working pressure is maintained by a pneumatic accumulator, which is a cylindrical tank, movable vertically and weighted to give the desired working pressure, and which is connected with the elevated lock and has sufficient volume to provide for such leaks as may occur and for changes in the density and temperature of the adjacent atmosphere. The depressed lock floats as a pontoon and requires no care.

The machinery connected with the locks, besides the



VIEW OF THE DECK.



VIEW OF THE BOWS.

ON WHEELS ACROSS THE SEA—THE NEW ROLLER STEAMBOAT ERNEST BAZIN.

required the maintenance of dry docks in the lower level big enough to contain the locks and their appurtenances, which land therein when they descend.

A lock is the heaviest of engineering structures, carries per square foot a load greater than the load per running foot of the heaviest railroad bridge, and is subject to tremendous and cumulative distorting forces. Therefore, a lock structure must be of simple type and extreme power, and automatically guided and controlled by apparatus strong enough to, beyond peradventure, arrest distorting forces in their incipency.

Locks and aqueducts are liable to be rammed by boats. In old fashioned structures either the structure or the vessel must be wrecked. A steel structure properly designed can cushion a blow so that it will be harmless.

The work done in perfecting the pneumatic lock may be briefly described as follows:

First: The substitution of compressed air for water as the support of the locks and vessels. Increasing the height of the air column does not increase the pressure, and therefore high lifts are operated with the same pressure which operates low lifts.

Second: The use of low pressures in lieu of high pressures, the air pressure being very little greater than that due to a column of water in height equal to the draught of the locks. The working pressure in the lock with 12 feet draught is 8 pounds per square inch; with 30 feet draught, 16 pounds.

containing the water for floating the boats, and working in a pit formed in the lower level.

2. A valve-controlled air conduit system, for transferring air from one lock to the other.

3. Anchorages to restrain the superbuoyant elevated lock, these being built integral with—

4. Guiding structures to prevent the locks from tilting sidewise.

5. Automatic parallel motion, or synchronizing apparatus, to keep them from pitching endwise.

The locking members are built of steel, and each like a long gas tank, with a gated lock built on top of it.

The gates move about a center, like a locomotive throttle valve, and when open lie back in pockets at the side of the lock, and have buffers or cushions which elastically cushion the blows of the boat.

The air conduits extend from the air chamber of one lock to that of its mate, and have a U bend which makes a valve like a sewer trap. When the trap is full of water the air conduit is closed, and when the water is drained out of the trap air can pass from one lock to the other. There are side guides to keep the locks from tipping over sidewise and automatic levelers to keep them from pitching endwise. This automatic leveling apparatus consists in racks built on the moving lock, fixed racks built parallel thereto on the piers, and shafts along the sides of the locks and carrying pinions which mesh with the racks on the locks and the parallel fixed racks. As the locks move, the shafts and pinions roll between the fixed racks and the lock racks with which they mesh.

interlocker and governor, are hydraulic stops or cushions, which stop the lock gradually to prevent shock, a hydraulic accumulator and pump, an air compressor to supply leakage and to transmit power to the gate-opening engines, the capstans which pull the boats in and out, and to the interlocking machine and valves.

The operation of the locks is as follows: The moving power is a surcharge of water in the elevated lock, containing, say, a foot greater draught than the depressed lock. If the boats enter or if they be left out it makes no difference in the weight, and when the gates are closed the locks are ready to be translated. If then the water be drained out of the big trap valve, the excess of weight in the elevated lock will cause the air to flow into the lighter depressed lock, which will ascend, and the heavier elevated lock will descend; the machine being controlled by the side guides which keep the locks from tipping sidewise, and by the synchronizing shafts and gearing, which keep them from pitching endwise and maintain them perfectly level and true; the motion being practically frictionless or attended only by rolling friction. As the surcharged lock approaches the lower level it automatically takes on an additional load of water, inducing a great increase in the compressed air charge, which increase, transmitted through the open conduit to the elevated lock, thrusts it firmly up against its anchors with a buoyancy, say, one-fourth to one-third greater than the weight of the lock and its load. The main air conduit trap valve is then shut by filling it with water, and the air chamber of the elevated lock is connected with the loaded air tank or pneu-

*Abstract of lecture before the Franklin Institute, November 13, 1897.

sequence of variations in the temperature or density of the adjacent atmosphere and also supplies such small leakage as is unavoidable. The gates of the depressed lock are then opened, and its buoyancy is increased so that it will float with just the desired depth of water with which it should rise.

The joint is then made between the elevated lock and the aqueduct face, and the space between the adjacent gates in lock and aqueduct is filled with water and the gates opened. The boat which has been raised is then swelled out into the aqueduct, or upper level, and the boat which is to descend is swelled into the lock, which at the same time is lowered and takes on the surcharge or greater draught of water which is the moving power of the system.

The distorting or destructive forces which are provided against are:

1. Shocks and blows due to bumping or ramming by the boats.
2. Sinking of the boats in one end or one side of the locks, producing uneven loading and tendency of the boat to tilt sidewise and pitch endwise.
3. Wind pressure.
4. Variations in the density and temperature of the adjacent atmosphere.

Provision is also made for raising the locks out of the water, so that they can be painted and repaired.

This invention substitutes steel for masonry and timber in lock structures, and renders feasible the building of canals with long levels and very high lift locks, few in number, and causing a little detention. Therefore it renders canals practicable in dry countries and over mountain ranges.

These locks give the engineer great freedom in planning his canal levels, and do away with the waste of water, as the canal bottom can be put down low enough to provide draught at the lowest water, and the banks carried high enough to hold the highest water.

BRIGG'S BICYCLE ATTACHMENT.

IN the accompanying illustration is shown attached to a safety bicycle a secondary handle bar, with merits and demerits which are obvious. The ideas which the inventor, Mr. Brigg, of Harley Street, London, W., has set himself to carry out are based upon perfectly sound physical and mechanical principles, as regards rest for



the back of the rider and increased purchase for hill climbing and back pedaling. As will be seen, the inventor fixes to the top bar of the frame of the bicycle a secondary handle bar, which is vertically rigid, but is connected to the ordinary handle bar by a spring for steering. This auxiliary bar is provided as a means of rest for the muscles of the back when riding easily on the level, but for hill climbing greater effort can be exerted on the pedals by using it as a fulcrum, in which case the rider, holding the front bar in the usual way and pressing up against the auxiliary bar with the arms, is enabled to put additional pressure upon the pedals. Such are the advantages derivable from this duplicate attachment, but whether they compensate for the increase of weight or are sufficient to alter a fashion in the shape of bicycles now fairly matured it is not our intention to comment.—The Engineer.

THE DE LAVAL STEAM BOILER.

A FEW years ago, in presenting the de Laval steam turbine to the Society of Civil Engineers of France, we concluded with the following words: "The de Laval turbine cannot at present, with the ordinary pressures of steam, consume more than 7.5 kg. of the latter per effective h. p. and per hour."

"With higher pressures, a still greater reduction in the consumption will be obtained, and this is the great future of these machines."

"We are far from the limit that generators will be able to reach. They operated at the outset at a pressure of 2 kg. and even at the pressure of the atmosphere. A pressure of 4 kg. was considered as dangerous. But pressures of 6, 10 and 15 kg. have been progressively reached, and there is no reason why one of 50 kg. or more may not some day be attained."

"Now, piston motors are incapable of running at such pressures, while the de Laval turbine will be able to utilize steam perfectly at any pressure whatever, since the latter is converted into live force before entering the motor itself."

"A more precise examination of the question gives an idea of the great saving that may be obtained from high pressures with the de Laval turbine."

Our provisions of that time are now realized and even exceeded. What was our desideratum at that moment is now a reality.

The same ingenious inventor who devised the first steam turbine has just brought out a boiler capable of furnishing steam at 220 atmospheres.

What particularly characterizes M. de Laval's boiler, aside from its high pressure, is its automatic operation and regulation. In fact, the feeding with coal, water and air and the regulating of the steam production are done by the apparatus itself.

The steam generator, properly so called, consists of a continuous tube, through one extremity of which the water is injected, while the steam escapes from the other.

The vaporizing tube is of cylindrical section and of from 25 to 30 mm. internal diameter, and forms a series of concentric spirals around a conduit through which

creasing strength, it closes in succession the apertures that allow the steam to pass to the ajutages.

The following operations take place automatically: The coal descends upon the grate and is carried along by its rotary motion; the apparatus, K, under the action of the steam, causes the operation of the registers, a_1 , a_2 and a_3 , which allow of the passage of the air introduced by the blower driven by the turbine; and the feed pump, G, is actuated by the turbine, as is also a centrifugal pump coupled directly with one of the driving shafts and supplying the condenser, B.

As soon as the machine is charged, its regulator

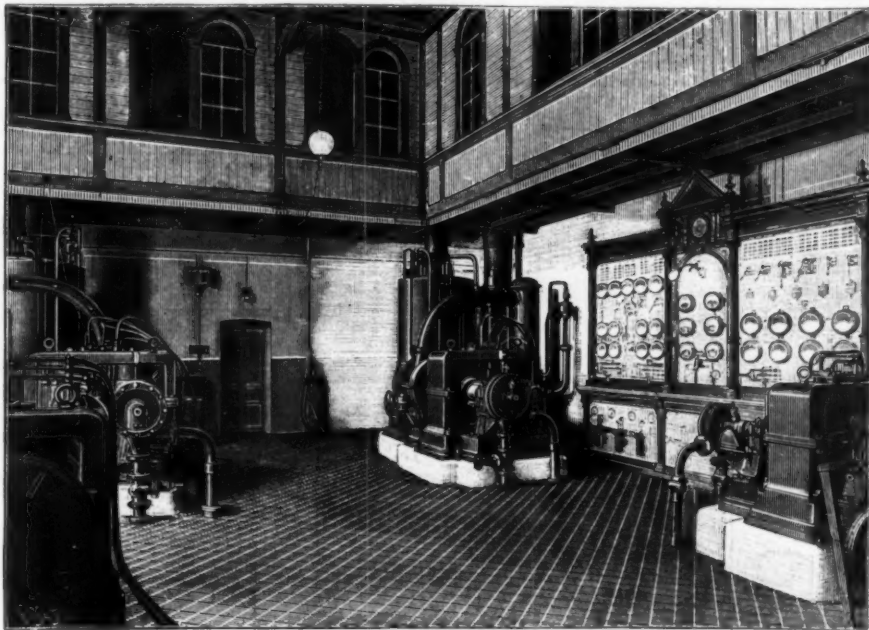


FIG. 1.—A DE LAVAL BOILER AND TURBINE AND A DYNAMO IN THE ENGINE ROOM OF THE JERLA WORKS, NEAR STOCKHOLM.

the coal is introduced. The whole is comprised in the annular space of an iron plate cylinder lined with heat-proof materials.

Below the conduit under consideration there is an arrangement which facilitates the continuous renewal of the coal and the cleaning of the grate. In the interior of a revolving grate, in the form of a truncated cone, there moves with a different velocity a cone of refractory bricks that carries along the fuel. Between the grate and the coal there is a loop in the water tube that performs the part of a scraper and keeps the grate constantly clean.

The boiler is provided with apparatus for regulating the supply of water and the admission of air into the furnace. The operation of these apparatus is based upon the action of balanced pistons by the pressure of the steam on one side and of the water under pressure and of springs on the other.

Fig. 2 gives a diagram of a complete installation of the boiler, turbine, condenser and accessory apparatus. The coal, which is introduced at the top, falls upon the cone, a_1 , and fills the conduit, a_2 , which is afterward closed. The reservoir, b_1 , as well as a portion of the spiral, is filled with water.

As soon as the fire is lighted, the steam begins to be disengaged at a_3 , and, through the regulators, D, and

opens the apparatus, E, slightly, the water loses some of its pressure, and the pistons of the apparatus, D, move in the contrary direction in allowing of the passage of a quantity of steam sufficient for the work required from the turbine.

The steam under a pressure capable of reaching 220 atmospheres (corresponding to 375° C.) enters the ajutages and completely expands therein up to the pressure of the condenser before being projected against the paddles of the turbine. After effecting its work, it goes to the surface condenser, B, whence, after condensation, it is forced by the pump, F, into the reservoir, b_2 , and is thence taken up by the feed pump, G, and forced into the steam generating tube.

The centrifugal pump keyed upon one of the auxiliary shafts of the turbine furnishes water under pressure to a sort of ejector, b_1 , which communicates with the space, b_2 , where the steam condenses and thus carries along the air that may chance to exist therein. After passing through the ejector, this water is directed into the condenser upwardly, and thence flows to the exterior. The centrifugal pump thus performs the office of both a circulating and air pump.

The apparatus, H, branched upon the conduit of the feed pump, in which there prevails a pressure higher than that of the steam in the generator, constantly

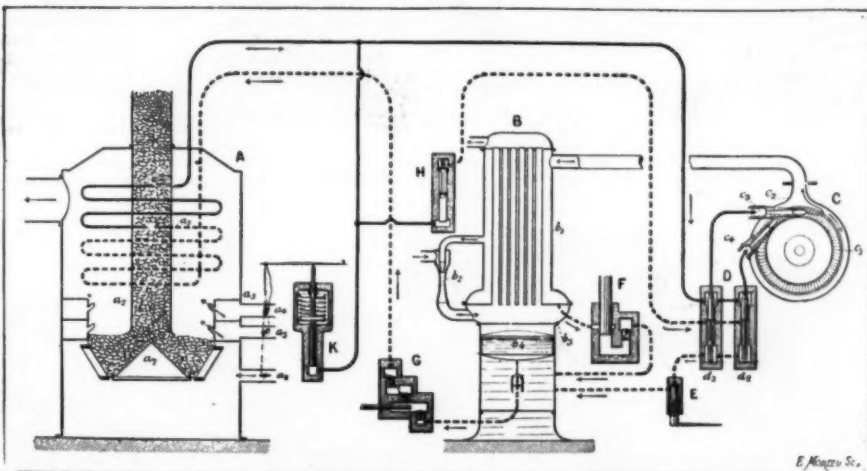


FIG. 2.—DIAGRAM OF A DE LAVAL BOILER.

A, the boiler; B, the condenser; C, the turbine; D, the steam regulator; E, the water pressure regulator; F, pump of the condenser; G, feed pump; H, apparatus for balancing the pressure of the steam and of the water circulating in the regulator, D.

the ajutages, e_1 , e_2 , e_3 and e_4 , enters the turbine, C, which revolves with greater and greater velocity in measure as the pressure increases.

The apparatus, E, which was completely open, and in which the water coming from the feed pumps, G, through the intermedium of the apparatus, H, circulated freely, begins to close through the action of the regulator and turbine. The pressure of this water, thus intercepted, progressively increases in the apparatus, D. In adding itself to the action of the springs, which are of unequal and progressively de-

balances the pressure of the water that circulates in the regulator, D, with the pressure of such steam and thus prevents the regulator from being always closed to the passage of the latter.

The blower, which is keyed upon one of the auxiliary shafts of the turbine, furnishes the quantity of air necessary for the combustion and produces the draught. The regulator, K, regulates both the action and the discharge of the steam, now opening and now closing the registers, a_1 and a_2 , according to the pressure of the steam and the charge of the machine.

Lastly, it is capable, while closing the registers, a_2 and a_3 , of opening the register, a_1 , and of thus blowing fresh air upon the spirals themselves so as to arrest the production of steam.

The boiler is capable of vaporizing from 35 to 40 liters of water per square meter of vaporizing surface and of furnishing from 7.5 to 8 kg. of steam at from 100 to 220 atmospheres per kilogramme of coal.

Among the principal advantages of the new boiler may be mentioned its simplicity, its lightness, the little space that it requires, the ease with which it may be installed and operated, the rapidity with which it is set in operation, its production of dry and superheated steam, etc.

The electric lighting of the Universal Exposition at Stockholm this year is assured by the de Laval turbines and high pressure boilers. The electric plant comprises four groups of 100 h. p. and two of 50 h. p. Each group is composed of one turbine, one dynamo turbine and one condenser, as well as the accessory apparatus for feeding and regulating actuated by the turbine.

The steam turbine manufactory at Jerla, near Stock-

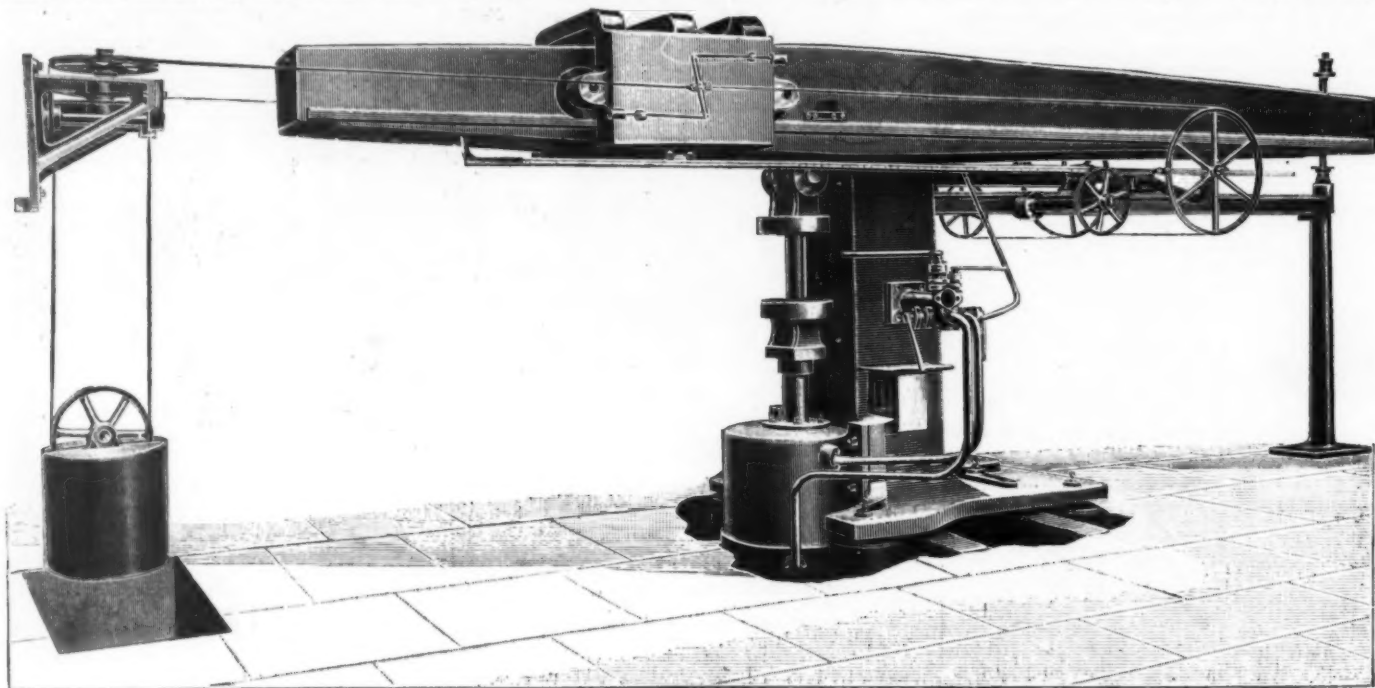
Grate area.....	2.51 sq. m. (27 sq. ft.)
Wheel base, fixed maximum.....	2,680 mm. (8 ft. 9.5 in.)
Wheel base, total.....	6,460 mm. (21 ft. 2 in.)
Feed water, in tanks.....	4 cubic meters (880 gal.)
" " in boiler.....	3.8 " (836 ")
" " total capacity.....	7.8 " (1,716 ")
Fuel.....	1.5 " (53 cub. ft.)
Weight, empty.....	55 tons.
Weight, in running order.....	69.9 " "
Axle load, maximum.....	14 " "
Gage.....	1,435 mm. (56.5 in.)

The engines have especially been constructed for pulling heavy trains on the steep gradient of 1:50 and 1:30 of some Thuringian mountain lines of the Prussian state railways, Probstzella-Wallendorf, Schwarzathal, Triptis-Blankenstein and Plaue-Ritschenhausen. The special conditions refer to gradients of 7.5 kilometers (4.7 miles) lengths and various minimum curves. On gradients of 1:30 and curves of 180 meters (590 ft.) trains of 250 tons were to ascend at a speed of 15 kilometers (9.3 miles). 110 tons were to ascend at a speed of 30 kilometers (18.6 miles); on gradients of 1:40 and curves of

object aimed at has fully been attained, for on gradients of 1:40 with curves of 200 meters (656 ft.) radius, trains of 296 tons have been pulled with a speed of from 17 to 30 kilometers (10.6 to 12.4 miles), and trains of 330 tons with a speed of 13 kilometers (8 miles); and on gradients 12.5 kilometers (7.7 miles) in length, of 1:50 with curves of 320 meters (1,050 ft.) radius, the required speed of 15 kilometers (9.3 miles) has been maintained with trains of 360 tons. The specified conditions have hence been more than fulfilled. The engines are said to move very smoothly, owing chiefly to the particular construction of the framing, which is not rigid, but linked, enabling the locomotive to take all curves easily and to adapt itself to irregularities in the track, without impairing the adhesion.—Engineering.

ONE HUNDRED TON TESTING MACHINE.

THE fine machine illustrated herewith was made by Messrs. J. Buckton & Company, of Leeds, for the Dowlais-Cardiff Works, where it is now in use. It is constructed under the Buckton and Wicksteed's patent, and is actuated throughout by hydraulic pressure



ONE HUNDRED TON TESTING MACHINE.

holm, is likewise run exclusively by these new boilers. In Fig. 1 is given an internal view of this station. To the right of the engraving may be seen a group of apparatus consisting of a boiler, a dynamo turbine, a condenser and various accessories.—K. Sosnowski, in La Nature.

THE HAGANS COUPLED LOCOMOTIVE.

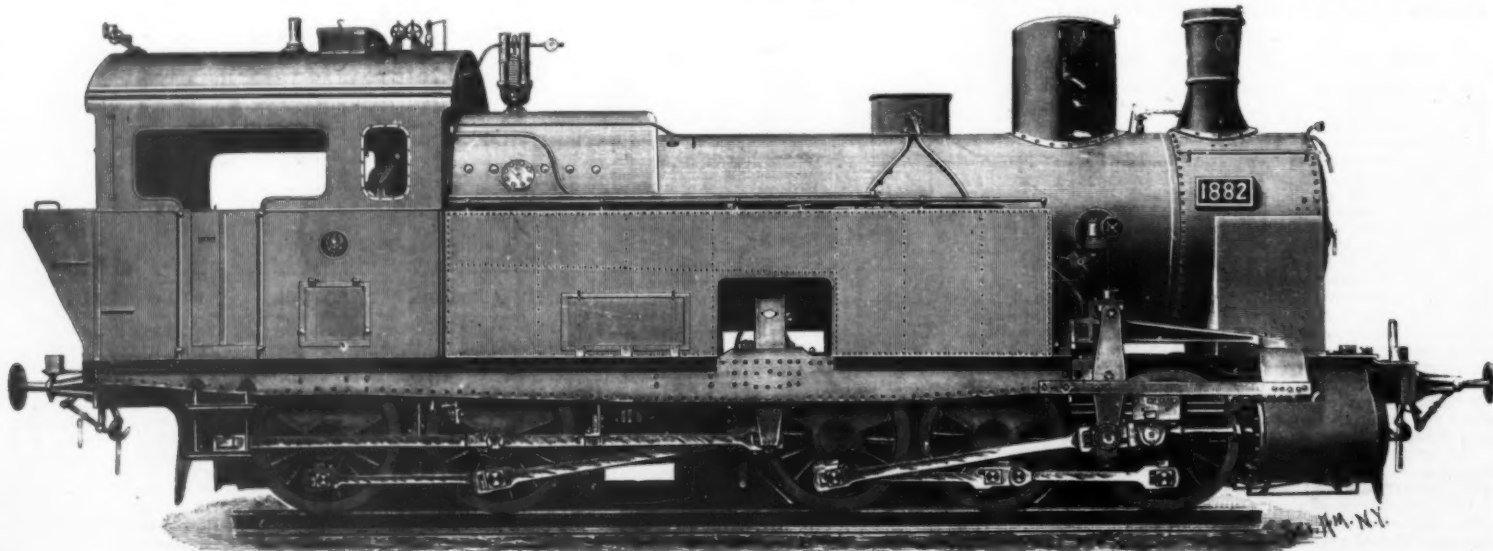
We illustrate herewith a locomotive built by the locomotive works of Henschel und Sohn, Cassel. The Prussian State Railway Department had originally ordered two of these engines; several more have already been added. Of the five coupled axles of these locomotives three have their bearings in the main frame, the other two in the bogie frame; the coupling is as described on the occasion referred to. The chief dimensions of this locomotive, which can pass over normal (1,435 millimeters) gage lines with curves of 180 meters (590 feet) radius, are:

Cylinders, in diameter ..	530 mm. (20.48 in.)
" stroke	630 " (24.8 ")
Wheels, diameter	1,200 " (47.2 ")
Steam pressure.....	12 atmos. (175 lb.)
Heating surface, direct.....	8.16 sq. m. (87.84 sq. ft.)
" indirect.....	129.05 sq. m. (1,389 sq. ft.)
" total.....	137.21 sq. m. (1,476.8 sq. ft.)

200 meters (656 ft.) the speeds were to be 15 kilometers (9.3 miles) for 270 tons and 30 kilometers (18.6 miles) for 160 tons; on gradients of 1:50 of 7.5 miles length and curves of 320 meters (1,050 ft.), speed of 15 kilometers (9.3 miles) was to be maintained for trains of 330 tons. For the calculations, coefficients of 0.18 (start) and 0.15 (run) were to be adopted for the friction between wheels and rails. The capacity for coal, 6 cubic meters (212 cubic feet) and for water, 7 cubic meters (1,544 gallons), were to suffice for runs of 20 kilometers (12.5 miles).

The load on each axle was not to exceed 17 tons, grate area and heating surface could not be dimensioned as in ordinary usage, but the designers have availed themselves of an expedient to which engine drivers resort in cases of forced runs, that is, to keep plenty of water in the boiler. The boiler has a diameter of 1,600 millimeters (63 in.), is raised a little above the firebox, and the firebox is made so low that it does not project more than 76 millimeters (3 in.) above the middle of the boiler. By these means the water level can be varied by 400 millimeters (16 in.); the boiler is, therefore, for all purposes, very spacious, and can carry 3.8 cubic meters (836 gallons) above lowest water level. The remaining 4 cubic meters of water are kept in a lateral tank; in these 3.8 cubic meters of heated water are stored up so that the engine can rapidly get up plenty of steam when arrived at the foot of a steep gradient. The

brought from the works' accumulator. The straining piston will put on a pull up to 100 tons at any desired speed, the speed being regulated by a hand lever on the hydraulic valve. Another valve admits the hydraulic pressure to a horizontal ram which actuates the traveling poise weight, which can be advanced along the steelyard at any desired speed by regulating the hydraulic valve. The result of this arrangement is that strong samples of plates up to 3 in. area in cross section can be tested with perfect accuracy as to their ultimate strength and total extension at the rate of sixty pieces per hour, and a record has been reached with lighter pieces of 120 in the hour. The gear which transmits the power from the horizontal hydraulic ram to the poise weight is so connected to the poise as to apply the force strictly in a horizontal direction, and to be incapable of supporting any part of the poise weight, or influencing in any way the sensibility in the oscillations of the steelyard. The machine is extremely massive, and the principle which enables such rapid testing to be delicately conducted is that of employing a very heavy poise weight with a very low velocity of oscillation. The steelyard is of the double armed type, invented by Mr. Wicksteed. The poise weight when at zero is at the end of the negative arm. In this position it is balancing an equal weight on the long arm or positive end of the steelyard, the result being that with



THE HAGANS COUPLED LOCOMOTIVE.

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A 30 cwt. traveling poise a total weight of three tons is utilized in measuring the strength of the sample, and the velocity ratio between the end of the steelyard and the testing shackle is only 33 to 1. The accuracy of the machine is guaranteed to 1 in 5,000, and although the steelyard and poise weigh together about four tons, yet they offer such small inertia resistance that the strength of sewing cotton can be measured on this machine with as much accuracy as with dust shot in a scale pan. The arrangements for returning the poise weight and the straining piston will be readily understood from the illustration. We are indebted to The Engineer for the engraving and article.

MACHINE FOR DRYING UP A MARSH OR FOR DRAWING WATER FROM A SHALLOW PLACE.

THE large bowls, A, B, which are to draw water from the reservoir, C, and raise it to the reservoir, D, are attached, through the extremity of their gutter, to iron pins moving upon the edge of the reservoir, D. They are suspended by the levers, E, F, at their end, F, through a forked link, G, H, and these levers, whose center of motion is at K, are drawn at their extremity, E, by two other links, L, M. These two last links being attached through an eye to the two cranks, N, O, of the wheel, P, raise and lower the levers, E, F, and consequently the bowls, A, B, when the wheel, P, revolves.

while there is current passing through the motors; a hand brake which acts upon the driving gear; and a third set which acts by gripping the rails, and which is under the control of the conductor as well as the driver. Everything has been done to secure safety and efficiency.

TYPE WRITER RIBBONS.

By ISIDOR FURST.

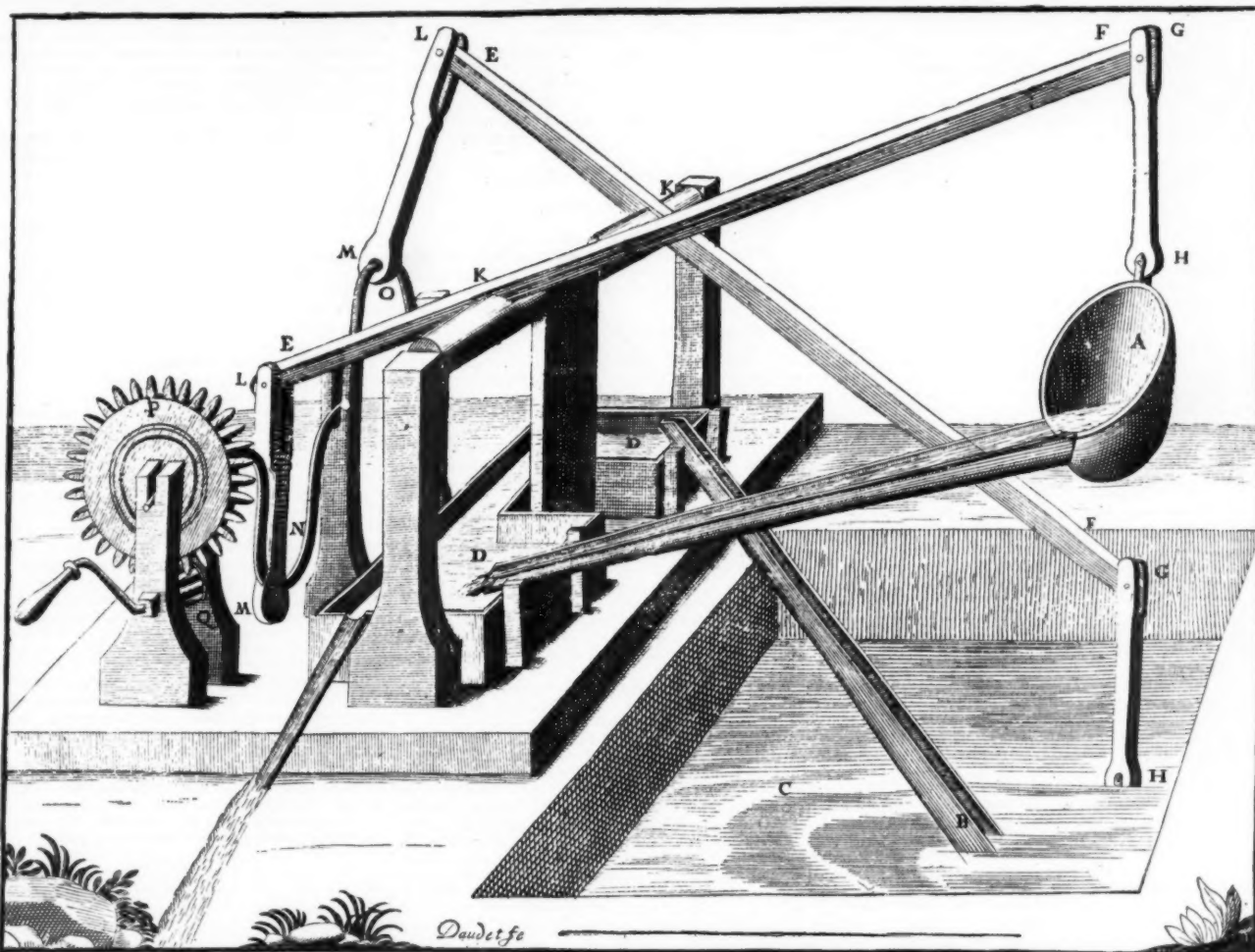
THE ever recurring query as to reinking type writer ribbons has been kindly referred to me by the editors of this journal.

In treating of this question the second time, I shall endeavor to put whatever knowledge I possess regarding it into such form as will enable any person of average skill to make an ink suitable for any particular style of ribbon and apply it. I mean to illustrate the principles involved and how to meet the various requirements. My reason for doing this, rather than to give a specific formula to be followed in every instance, is that often an experimenter has already produced an ink which lacks only some correction to make it entirely suitable; for "there are many ways leading to Rome." Besides, an ink which may have been suitable at one time may fail at another, under different conditions, and once a person knows how to correct a defect, the ink may be made to answer all purposes.

The constituents of an ink for type writer ribbons may be broadly divided into four elements: 1, the pig-

After thus having explained the principles underlying the manufacture of permanent inks, I can pass more rapidly over the subject of copying inks, which is governed by the same general rules. Personally I am not in favor of the use of copying ink; first, because the print is liable to fade, smear and become invisible; second, because it is unsuitable for legal and other documents of value; third, because it is easier to write two or more copies at one operation with manifold (carbon) paper than to make a second press copy after the writing is done.

For copying inks, aniline colors form the pigment; a mixture of about three parts of water and one part of glycerine, the vehicle; transparent soap (about one-fourth part), the corrigent; stronger alcohol (U. S. P.) (about six parts), the solvent. The desired aniline color will easily dissolve in the hot vehicle, soap will give the ink the necessary body and counteract the hygroscopic tendency of the glycerine, and in the stronger alcohol the ink will readily dissolve, so that it can be applied in a finely divided state to the ribbon, where the evaporation of the alcohol will leave it in a thin film. There is little more to add. After your ink is made and tried—if too soft, add a little more soap; if too hard, a little more glycerine; if too pale, a little more pigment. Probably printer's copying ink can be utilized here likewise, because everyone now has the means to modify and correct it to make it answer the purpose. I have not tried it, because I am opposed to copying inks. Users of the type writer should so set a fresh ribbon as



MACHINE FOR DRYING UP A MARSH OR FOR DRAWING WATER FROM A SHALLOW PLACE.

This latter is actuated by hand through a winch that one places at the end of the axle of lantern wheel, Q.—From *Recueil d'Ouvrages Curieux de Mathématique et de Mécanique*, 1733.

LOCOMOTIVES FOR JUNGFRAU RAILWAY.

THE Jungfraubergbalne locomotive is said to be the most powerful cogwheel locomotive which has ever been constructed, and it will be granted that it has the advantage, if that is anything, of a very long name. It is being built by Messrs. Brown & Boveri, of Baden, for working the trains on the gradients of the Jungfrau; and as it is of peculiar design, unlike anything of the kind on any other mountain railway, we give a few particulars which we extract from the description appearing in a Swiss contemporary. As its name implies, it is driven by electricity, through the trolley, and the motors are contained within a passenger car. This combination of engine and car gives great weight on the driving wheels; and the cogwheels, by which adhesion is obtained, are the less likely to rise out of the rack, which extends the whole length of the line between the rails.

The frame of the car contains, between the two supporting axles, the two driving axles, on which are the cogwheels. Two electromotors, each of 125 h. p. at 800 revolutions, drive, by means of double reduction gearing, the main cogwheel. The highest output of these motors will be 300 h. p., corresponding to about 285 apparent kilowatts, or about 235 amperes per phase, at a pressure of 500 volts. The gear pinions are of aluminum bronze, the large spur wheels and the driving cogwheels of cast steel. The latter are made as large as possible, in order to have a good grip of the teeth in the rack and as little wear from friction as possible. It is important that a mountain locomotive should be well provided with brakes, and this has three different varieties—an electric brake on the motor shaft available

ment; 2, the vehicle; 3, the corrigent; 4, the solvent. The elements will differ with the kind of ink desired, whether permanent or copying.

Permanent (Record) Ink.—Any finely divided, non-fading color may be used as the pigment, vaseline is the best vehicle, and wax the corrigent. In order to make the ribbon last a long time with one inking, as much pigment as feasible should be used. Suppose we wish to make black record ink. Take some vaseline, melt it on a slow fire or water bath, and incorporate by constant stirring as much lampblack as it will take up without becoming granular. Take from the fire and allow it to cool. The ink is now practically finished, except, if not entirely suitable on trial, it may be improved by adding the corrigent wax in small quantity. The ribbon should be charged with a very thin, evenly divided amount of ink. Hence the necessity of a solvent—in this instance a mixture of equal parts of petroleum benzine and rectified spirit of turpentine. In this mixture dissolve a sufficient amount of the solid ink by vigorous agitation to make a thin paint. Try your ink on one extremity of the ribbon; if too soft, add a little wax to make it harder; if too pale, add more coloring matter; if too hard, add more vaseline. If carefully applied to the ribbon, and the excess brushed off, the result will be satisfactory.

On the same principle, other colors may be made into ink; but for delicate colors, albolene and bleached wax should be the vehicle and corrigent, respectively.

The various printing inks may be used if properly corrected. They require the addition of vaseline to make them non-drying on the ribbon, and of some wax if found too soft. Where printing inks are available, they will be found to give excellent results if thus modified, as the pigment is well milled and finely divided. Even black cosmetic may be made to answer, by the addition of some lampblack to the solution in the mixture of benzine and turpentine.

to start at the edge nearest the operator, allowing it to run back and forth with the same adjustment until exhausted along that strip; then shift the ribbon forward the width of one letter, running until exhausted, and so on. Finally, when the whole ribbon is exhausted, the color will have been equally used up, and on reinking, the work will appear even in color, while it will look patchy if some of the old ink has been left here and there and fresh ink applied over it.

According to the directions here given, I have done nearly all the reinking of my ribbons for more than seven years, and I am sure, if the reader should fail, it will be due to inattention on his part to some of the principles laid down.

We are indebted to the American Druggist for the above particulars.

HISTORY OF TINFOIL.

TINFOIL was invented early in the fifties by John J. Crooke, a young man connected with the drug and chemical trade of New York. Crooke's inventive tendencies led him outside of his regular business, and he endeavored to perfect a method of coating iron bolts with copper, as a substitute for the copper bolts which he saw being used in shipbuilding. In this he was unsuccessful; but it is stated that the experiments led him up to the combining of other metals, and he devised the plan of rolling tin upon lead sheets, producing a sort of weld between the two. Before this the only tin-foil known was pure tin beaten out into sheets as gold leaf is.

A patent was obtained on the invention, and the production of the material was begun at Nos. 335-7 Stanton Street, New York, some pure tinfoil being also made. A business card of this establishment has been preserved, which bears the inscription: "Foil Rolling Mill and Metallic Cap Works; tobaccoists"

foil, plain or embossed, tin sheet foil for druggists and bottles, superior to imported article."

The new foil was first used for the wrapping of fine cut tobacco, which had previously been wrapped in paper only. Its advantages for this purpose were obvious, including its slightly appearance and its property of keeping the tobacco moist.

The printing or stamping of names and designs upon the foil was a speedy outgrowth of its manufacture, which was stimulated, after the imposition of internal revenue in war times, by the printing of the internal revenue stamp directly upon the tobacco wrappers. A contract for this work was obtained by Mr. Crooke from the government after many complaints of fraud and loss to the revenue through difficulties connected with the use of paper stamps.

Vast quantities of the foil are used for the packing of domestic Limburger cheese, the material being sent to the Northwestern States for that purpose by the car load. The wrapping of cigarettes in tinfoil is a comparatively new development, the importance of which is manifest when the extent of cigarette manufacture is considered. About one-half of the output of the Crooke factory is rolled pure tin, as the proprietors always insist that only this shall be used when the foil wrapping is to be directly in contact with food. Large amounts are taken for the packing of yeast cakes and also for fancy cheese and other food products of the "delicatessen" order. A great demand for the pure tin comes from the manufacturers of plug tobacco, who use it for the wrapping of the separate plugs and also in sheets between layers of the tobacco. When a machine for packing tobacco was invented, which required tinfoil and paper to be fed into it altogether, a process was devised by which the foil was furnished already backed with thin paper and firmly adhering to it. The pure tin, by the way, is not used for the Limburger cheese wrappings, but the foil of tin and lead, as there is an inner wrapper of paper. Besides, it is probably thought that nothing could hurt Limburger anyway.

The embossing of the foil in various ornamental designs is a branch of the business which has gradually developed until now highly artistic results are obtained. In the fancy patterns, the silvery surface is diversified in bright and "dead" effects, by stars, plaids, flowers, bars, diagonals, lines, etc. Many samples are printed in colors, such as pink, blue and red, both the colors and the patterns being produced by putting the sheets of foil through a process of regular cylinder printing. Other specimens are lacquered with gold and embossed in various forms, presenting a beautiful appearance, and still others are brilliantly lacquered in colors. Confectioners, druggists, cigar manufacturers and cigar box makers use quantities of these fancy designs, many of which are specially made for particular firms and serve as a sort of trade mark. The thickness, or rather the thinness, of the foil runs from 0.0005" upward, the thinnest being the most expensive, as representing the most labor. It is rolled in sheets, which on the average are 50" long and 5½" wide (some also being rolled as wide as 12"), and is then cut into the lengths desired.

The makers of bottle caps are not classed with the tinfoil manufacturers, as these caps are not made of the regular foil, but are spun on a lathe from a mixture of lead and tin. Besides the John J. Crooke Company there are now four tinfoil factories in this country, two in New York, one in Philadelphia, and one in St. Louis. These four were started after the expiration of the original Crooke patent. The foil is also made in England, France and Germany, its production being especially large in the last named country. Owing to the impossibility of competing with foreign labor in its manufacture, the United States has no export trade in the article, except a little to Havana, where it is used in the packing of cigars.

The output of tinfoil in this country amounts to millions of pounds a year, but there are no data accessible on which to base exact or even approximate figures. The market price of the most expensive embossed and lacquered foils runs as high as 75 cents a pound, and from that it goes down so low that manufacturers do not care to quote the minimum rates. It is said that the average price has been reduced one-half within the last fifteen or twenty years, being lower now than ever before since the foil was invented. This was due to increased facilities of manufacture, increased production, and, especially, keen competition, particularly in the lower grades of the product.

There is constant improvement in the machinery and processes of tinfoil making and also in the article turned out. New uses for it are discovered yearly. Its chief merits as a wrapping are its pleasing appearance, its adaptability to ornamentation, its keeping in place as paper, and above all, its preservation of the contents from drying.—Tin and Terne.

HOT SODA WATER FOUNTAIN FOOD PREPARATIONS.

Bouillon.

Extract beef..... 3 ounces.
Water 2 pints.
Corn starch..... 1½ ounces.
Salt 2 "

Boil the corn starch with the water until the starch is thoroughly cooked; then add the extract of beef dissolved in 8 ounces of hot water; add the salt, and when dissolved make the finished product measure 2½ pints. To draw this use about 1 ounce to a 6 ounce mug and flavor with a few drops of a flavoring essence composed of tincture of summer savory, 3 ounces, and tincture capsicum, 2 drachms.

Hot Tomato Bouillon.

Beef extract ½ to 1 teaspoonful.
Or
Liquid beef extract .. . about 1 fl. ounce.
Tomato catsup about ½
Hot water, enough to fill an 8 ounce mug.
Season to taste.

Beef and Celery.

Liebig's extract of beef..... 8 ounces.
Hot water 1 pint.
Extract of celery 1 drachm.
Caramel..... 1 "

Mix beef in hot water, add celery and color, use a shaker top in the bottle, as there is a sediment in the beef extract which necessitates shaking. In a six or seven ounce cup shake about two teaspoonfuls of the beef extract prepared as above, draw on this sufficient hot water, add salt to suit taste, stir with a spoon, shake a little white pepper on top.

Hot Clam Shake.

Clam juice..... 2 ounces.
Hot milk..... 4 "

Shake well, add pepper and salt, stir well and serve.

Hot Clam Bouillon.

Clam juice..... 1 ounce.

Fill mug with hot soda, add pepper and salt, stir well and serve.

Hot Clam Broth.

Clam juice..... 1½ ounces.
Hot Milk 2 "

Fill mug with hot soda, add a sprinkle of salt and white pepper, stir well and serve.

Hot Ginger Clam Broth.

Powdered Jamaica ginger..... 1 teaspoonful.
Cream 1 ounce.
Clam bouillon..... 1 "
Butter, sufficient quantity.
Celery salt, sufficient quantity.

Fill mug with hot soda, stir well and serve.

Mock Turtle Extract.

Extract of beef 2 ounces.
Concentrated chicken .. . 2 "
Clam juice 8 "
Hot water 3 pints.
Tincture of black pepper .. 1 ounce.
Essence of celery 3 drachms.
Essence of orange peel .. . 1 "

Mix and dissolve thoroughly. To dispense.

Mock Turtle Bouillon.

Mock turtle extract 3 ounces.
Sweet cream..... ½ "

Stir while adding hot soda. Serve spices. (Bonham's Guide).—Pharmaceutical Era.

DISINFECTANT SOAPS.

MR. S. RIDEAL, D.Sc., scores a good point in his paper on this subject, read before the British Pharmaceutical Conference (Pharmaceutical Journal), and contending that although our knowledge of disinfectants has much increased, very little progress has been made with disinfectant soaps, many of those which have been in use for years having little germicidal power. Many valuable disinfectants are quite unfit for use in soaps.

The conditions under which a disinfectant soap acts are very different to an ordinary disinfectant. The time of contact is less, and also the volume of water, and the disinfectant to be effective must be readily soluble in water.

With essential oils and coal-tar products, although emulsified by the soap, their effect is uncertain in soaps, owing to the length of time necessary to produce the death of the most resisting of the organisms.

A base of oleate is preferable to one of stearate or palmitate, as sodium stearate or palmitate is thrown down by hot water (F. Krafft and A. Stern).

Some experiments are required on a basis consisting of soda and potash soaps mixed. Unna suggests that medicaments are more easily absorbed if the soap be superfatted, but for use with disinfectants an excess of alkali is preferable, as fats retard disinfectant properties. Lenti showed that fatty solutions are unsuitable bases for disinfectants. Dr. Breslau has confirmed this, lanolin being the least objectionable as a basis. Oils and fats for ointments and soaps should be sterilized by heat, as they often contain germs. This is usually done in process of manufacture.

Soaps have considerable disinfectant power, and the action is more marked with cold than with hot water. Prolonged contact with soap renders surfaces practically sterile.

Acids and halogens are obviously unsuited for soaps. Hypochlorites are compatible to a certain extent.

Fluorides and silico-fluorides were found by Thompson to be strongly antiseptic, and they are compatible with soap.

Sulphur and alkaline sulphides blend well with soap, and are useful in skin diseases; but sulphur is slow in action on account of its insolubility. Alkaline sulphides are caustic, and recently ichthyol has been suggested. Most of these gradually evolve H₂S, and are not popular.

Boric acid would be converted into borate, and have little value.

Metallic salts, except Na and K, are precipitated in an insoluble form.

Oleates.—These have been proposed for soaps, but as the oleates of most metals are insoluble in water, it is a question how far an oxide or oleate can be used for washing. Zinc hydrate boiled with sodium to form sodium zincate as neutral as possible, incorporated with yellow soap, showed no sign of separation of insoluble oleate.

Manganese soap is said to be strongly siccativ. It is made by decomposing manganese sulphate with soap.

Arsenical Soaps.—The small quantity of arsenic present is useless for antiseptic purposes, but in constant use might have some effect on the skin.

Mercury Soaps.—It is difficult to prevent the formation of mercuric oleate, which is insoluble and of little value. The double iodide of K and Hg has stronger germicidal powers than HgCl₂. It is easily incorporated with soap, and there is no separation when dissolved in warm water. The strength recommended is one-third of HgI₂, and one-third of KI in 100 of soap. It is said to be effective in the proportion of one part of HgI₂ in 4000 of water. A soap of this kind which is on the market contains more KI than is sufficient to form the double salt. Potassio-mercuric iodide is compatible with strong alkalies, does not precipitate albu-

men, and is not easily reduced. The carbolate of mercury soap is not so powerful, and is slower in action. Dr. Rideal concludes that a metal in the form of an oleate is readily absorbed by the skin, and that oleate soap would be useful if an internal effect is required, but for local antiseptic or disinfectant purposes the metal must be presented in a soluble form to water, as in the zinc soap mentioned above, or mercuric iodide soap. This is the natural use for soap; the other action more properly belongs to the ointment.

Carbolic and Cresylic Soaps.—The odor of these soaps is an objection. A number of toilet soaps are advertised in conjunction with the names of disinfectants, but contain so small a quantity as to be quite useless as germicides.

Essential Oils.—The disinfectant powers of essential oil have been much overrated, and are often irritating when used in disinfecting quantities. When such ingredients are added to the "crutching pan," it is always necessary to neutralize the free alkali at this stage by the ammonium salt process, or to postpone the addition of the oils until after the operation of fitting. Volatile disinfectants, such as phenol, camphor, thymol, etc., suffer considerable loss if introduced in crutching in the ordinary manner, or added during melting, so that the quantity present becomes uncertain. Such medicinal soaps should be milled or plotted. The cakes should be packed in tinfoil (mercury soaps in oiled paper or gutta-percha tissue). It has been suggested to coat the surface of the cakes with gelatin.

In a series of experiments made in 1896, using two per cent. solutions and broth cultures at 37° C. of two representative organisms, Dr. Rideal found soap with oil of cloves to have little antiseptic action, scarcely exceeding that of curd soap. Carbolic soap (3 lb. per cwt.) was about the same. A series of experiments, not yet complete, shows at present the following results with B. coli communis and two per cent. solutions.

Curd soap, sterile between one and three hours.

Zinc soap (made as described in paper), alive after three hours.

Carbolic soap, sterile between one-quarter and one hour.

Coal tar soap, sterile between one quarter and one hour.

Sanitas soap, alive after three hours.

Terebene soap, alive after three hours.

The variations in these are due to the varying amount of water present.

IRON AND STEEL PRODUCTION IN FRANCE.

SOME official returns have just been issued regarding the metallurgical production in France during the first half of the current year, from which we compile the following few brief particulars. The returns show that the total output of pig iron in the country during that period amounted to 1,223,638 tons, or an increase of 77,044 tons over the first half of 1896. The production of forge pig is returned at 977,719 tons, as against 893,909 tons in the first six months of 1896, and of foundry pig 245,919 tons, as compared with 232,685 tons.

Meurthe-et-Moselle continues to be by far the leading French pig iron producing center, this district being responsible, during the first half of the current year, for 761,199 tons, as compared with 719,861 in 1896, or considerably more than half of the total output in the country.

The second principal district is the Nord, where the output of crude metal for the six months totaled 145,000 tons, while in the Nord the production increased from only 18,851 tons in the first six months of 1896 to 26,422 tons this year.

As regards the finished iron trade the output, as will be seen from the following table, has declined, as compared with the second half of last year, to the extent of 17,281 tons, although it is 14,030 tons better than was recorded in the first six months of 1896:

	Jan.-June. 1897. Tons.	July-Dec. 1896. Tons.	Jan.-June. 1896. Tons.
Iron bars.....	369,747	376,172	347,885
" rails	372	459	417
" plates and sheets.	35,577	46,346	43,364
Total	405,696	422,977	391,666

In this branch the Nord continues to occupy the leading position, with 152,610 tons, as against 141,711 tons in the past six months of last year, followed by the Ardennes, where the production, however, increased but slightly from 47,012 tons in 1896 to 48,555 tons in 1897.

The steady progress in the steel trade has been well maintained, the production during the period under review showing, as given below, a satisfactory increase over both the two preceding half years:

	Jan.-June. 1897. Tons.	July-Dec. 1896. Tons.	Jan.-June. 1896. Tons.
Steel bars.....	270,953	283,020	218,042
" rails.....	95,426	82,286	88,389
" plates and sheets	108,440	105,666	106,103
Total	474,819	470,972	412,536

In both the Nord, the Meurthe-et-Moselle and the Saône-et-Loire districts the output of steel is undergoing a steady development. The Nord leads the list with 96,245 tons for the six months as compared with 71,548 tons in the first half of 1896, or an increase of roundly 24,000 tons, while in the Meurthe-et-Moselle the output totaled 61,747 tons, as against 56,943 tons.—Colliery Guardian.

One of the nicest ways to draw temper on a long, slender tool, like a stay bolt tap, is to use a piece of gas pipe. Run the pipe through the fire, making the fire long enough to accommodate it, and put in your tap, turning it and watching it, and you can get the nicest sort of heat. Some tool hardeners do their heating to harden in a pipe. Where much of this kind of work is to be done, the device can be improved, as, for instance, by the use of permanent supports for the pipe. Smiths are prolific in rigging up devices and can easily extend and elaborate the idea.—Sparks.

ELECTRICAL NOTES.

An isolated electric plant was recently installed in a large tea firing or curing establishment in Yokohama. This establishment employs 2,000 people, who clean and sort the tea by native fan blowing and sifting machinery, after which it is taken to the firing rooms, containing 1,500 pots, set in brick work and heated by a slow fire, the tea being stirred continuously by the coolie who attends each pot, the work going on day and night during the busy season.—Philadelphia Record.

At present there are in use in America from 150 to 200 miles of street railway track the joints of which have been all welded, either by the electrical or the "cast welding" system, so that the rails are actually continuous. As to the success of this system, the testimony is rather conflicting; but the fact appears to be that the difficulties encountered have been no more serious than might naturally be expected to accompany so novel a departure from usual practice. The cast welding system promises to supersede the electric welding system, says The Engineering News, because it produces as good or better results at a less cost. Unless some further trouble should develop, or those already found should prove more serious than they thus far have done, it seems quite probable that the street railway track of the future will have a continuous rail, at least wherever it is laid in paved streets.

The possibility of finding for aluminum a wide field of usefulness as an electric conductor has very frequently been discussed—not without hope on the part of the producers of the new metal—but there have not been sufficiently reliable data, the tests of the conductivity of aluminum as compared with copper showing a very low result. This, it has now been proved, is due to the fact that the aluminum tried had been impure, a small percentage of foreign element making a material difference. Some very careful tests have been made on behalf of one of the American technical institutes (the Franklin), and these show very favorable results. Thus aluminum with 1.5 per cent. of impurities was found to have little more than one-half of the conductivity of copper, or 55 per cent.; while, when the impurities were reduced to 1 per cent., the conductivity increased to 59 per cent. that of copper; with $\frac{1}{2}$ or 0.5 per cent. of impurities the conductivity became 61 per cent.; and with absolutely pure aluminum it was found that copper was only one-third more powerful as a conductor, or that it was a case of 67 for aluminum against 100 for copper. The question therefore arises as to whether pure aluminum can be produced 33 per cent. more cheaply than copper of the same capacity. There seems every reason to believe that it can be. The same research committee found that the conductivity of hard drawn commercial aluminum was nearly 1 per cent. higher when annealed.

An interesting paper by Trabert, on the crackling of the telephone on the Sonnblick, appears in the fourth report of the Sonnblick Verein. The Sonnblick, it may be stated, is one of the best known mountain observatories in the world, by reason of its height (10,154 feet), and especially by reason of the valuable results which have been derived by Hann and others from the observations there made. For six years, says Science, five observations a day have been made of the intensity of the crackling in the telephone at the summit. It appears from these data that in December the minimum crackling is at noon, with the maximum at 9 P. M., and a secondary maximum at 7 A. M., while in June there is a steady increase in the intensity of the noise from 7 A. M. to 9 P. M., without a noon minimum. The other months of winter and summer follow respectively the same rule as December and June, while the intermediate months, as expected, present the intermediate conditions. Further, the noise is greater in summer than in winter. Regarding the explanation of these phenomena, the author finds it chiefly in the presence of atmospheric electricity in the clouds over the Sonnblick, for there is a very striking correspondence between the crackling and the cloudiness on the summit, not only in the diurnal period, but in the annual as well. The days on which there is the greatest intensity of crackling are almost invariably distinguished by cloudiness, rain, snow or thunderstorms. The part played by earth currents must not be overlooked, for on one cloudless anticyclonic day there was a very well marked crackling, which could not be explained as being due to atmospheric electricity.

Some statistics on lightning strokes compiled by the war ministry of Austria-Hungary may at first glance appear rather puzzling, says The Trade Journals Review. They refer exclusively to fortifications and buildings under this department. During 1893 there were 7,979 such buildings, in 3,642 groups. Of these, 1,086 were provided with lightning protectors; the far greater number of 6,893 buildings were without conductors. Forty-two buildings were struck; 29 of those were protected. That is to say, 2.67 per cent. of the protected buildings were struck and only 0.19 per cent. of the unprotected. In 1894 those percentages were 3.25 and 0.987; in 1895, 7.41 and 0.086. The increase in 1895 looks very peculiar; but it turns out that this increase concerns only one district, that of Cattaro, in Dalmatia, where thunderstorms are always frequent, and that on the whole the year 1895 was not exceptional in thunderstorms. Then there is the very marked preference of lightning for protected buildings, which seems to suggest that conductors are worse than useless. The statistics comprise, however, all cases where lightning has taken the path provided for it, and on the whole they prove that the conductors have done their duty. Without going into technical details, the able analysis of the statistics by Dr. Wächter, in the Mittheilungen des Artillerie und Genie Wesens, establishes that, whatever be the theory of lightning conductors, we are not wrong in fitting exposed buildings with conductors joined to the underground water. The old-fashioned plates, buried in holes packed with coke, failed in many instances. The preference of lightning for certain conductors, some of which were struck, several up to 21 times, simply proves that the conductors were placed in suitable places. The present paper does not deal with different types of conductors, these having been discussed by Col. Hess in 1889.

MISCELLANEOUS NOTES.

Trondhjem, the ancient capital of the Norwegian kings, is celebrating the 900th anniversary of its foundation.

The directors of the Furness Railway Company have decided to abolish second class passenger accommodation; but supplementary reserved tickets will be issued to holders of third class tickets at a small extra charge. The carriages will be labeled "Reserved tickets." This is an entirely new departure in the conduct of railway passenger business.

It appears that from the town of Lee, in western Massachusetts, come some of the strongest marbles in the world, as they are found equal to bearing a weight of 13,400 pounds to the cubic inch; but the strongest American limestone comes from Kingston, N. Y., showing a capacity to stand 13,900 pounds pressure to the cubic inch. Tuckahoe marble will bear 12,950 pounds to the cubic inch, this being more than the well known red granite of the Bay of Fundy region, the limit of this latter material being 11,812. The trap rocks of New Jersey and the dolomites of Staten Island are rated the strongest stones in the United States, their crushing resistance being 24,000 pounds to the cubic inch. Rhode Island granite crushes at 17,750 pounds to the cubic inch, that of Virginia will bear 21,500 pounds, and that from the quarries of Maryland 19,750 pounds. New England granites, in general, vary somewhat from these standards.

The Paris correspondent of the British Medical Journal mentions a curious case reported to a Bordeaux society by Dr. Ginostot. The subject was a young man who has, since the age of ten years, had an irresistible impulse to count the letters contained in a word or phrase that he hears, sees, speaks, or thinks. This habit is practiced from the time he wakes to the time he goes to sleep. At night he sleeps without dreaming. When he does not talk, he invents phrases and counts the letters in them. Thirty-two is a number which gives him satisfaction; thirteen displeases him, but nevertheless he does not recoil from arranging phrases with thirteen letters. This unceasing automatic operation does not in any way interfere with his daily work, or reading, or carrying on a conversation. Unless previously informed it would be impossible and extremely difficult for any one to detect the silent mental labor the young man—he is now twenty-seven—is always engaged in.

Colored glasses are generally produced by fusing oxides with the glass; the whole mass is colored. Léon Lémal colors the surface by penetration, and obtains, according to La Nature, colored patterns of striking novelty. A bit of silver salt is placed on the glass, and the glass heated up to 500° or 550° C.; the excess of salt having been removed, the surface will appear of a more or less deep yellow. The depth to which the color penetrates depends upon the time, the shade upon the quantity of salt applied. In five minutes, the top layer of glass, 0.17 millimeter in thickness, was colored; after an hour, that thickness was doubled; in eighteen hours, a plate 1.6 millimeter ($\frac{1}{16}$ inch) thick was colored throughout. The color appears both in reflected and transparent light, and the yellow is said to be distinguished by a fine greenish or bluish fluorescence. Other metallic salts can be used, gold, copper, iron; silver with a little copper gives a red. The process is exceedingly simple. To transfer a lace pattern upon glass, it suffices to dip the lace into very diluted solution of nitrate of silver and then into potassium sulphide. Photographic collodion negatives can be directly applied to the surface.

In a paper on "The Use of Wind Power in Village Water Supply," in the Journal of the Royal Agricultural Society, of England, Mr. A. L. Y. Morley describes the method which has been successfully pursued in securing an adequate and constant supply of water in two adjoining villages on Lord Spencer's estate in Northamptonshire. The supply of water is obtained from a depth of 200 feet, and is pumped by means of one of Titt's simplex wind engines into a reservoir on the side of the hill, from which at 465 feet above the sea level the water flows to the various points of consumption by natural gravitation. The reservoir is a double one with a capacity of 180,000 gallons. The winter consumption is about 5,000 gallons per day, but in summer when stock are at pasture about 1,000 gallons extra are needed. A population of some 600 people is supplied with water all the year round, and the standards, by Guest and Chrimes, from which the water is drawn, are ingeniously arranged so as to avoid waste through carelessness on the one hand and obstruction from frost on the other. The cost of the reservoir was £530, and of the wind engine £275, the total cost of the entire works, including the considerable lengths of iron piping required, being £2,250. During the four years the works have been in operation there has never been the least anxiety lest the water supply should give out through failure of wind power.

An English journal states that "Australia is going to give us a surprise in the shape of a consignment of two tons of sample tobacco which are now stored at Wangaratta awaiting a touch of humidity in the final stage of treatment before being shipped to England. The Victorian Agricultural Department is sending it on, and it will be packed in the American style, in hog-heads of half a hundredweight each. In quality it is said to be like the tobacco of Kentucky, Missouri and Ohio, and more Western States, rather than like that of Virginia, but it would not necessarily be inferior on that account, especially if the comparison should apply to the Maryland growth, which is the prime favorite in the States. However, there is a wide scale of prices as there is a wide range of qualities. Virginia leaf realizes here all the way from 3d. to 7d. per pound, bright leaf from 4d. to 14½d. per pound, dark Virginia stripped leaf (with the stalks taken out) from 4d. to 10d. per pound, and bright leaf stripped from 4½d. to 15½d. per pound. The Victorian article is a medium colored leaf, the dark and light qualities being intermixed. Heavy dark tobacco, with which the Victorian leaf will probably rank, fetches in the English market 7d. to 8d. per pound for prime, while stripped Western brings 7½d. to 8d., short to middling 5d. to 6d. and the lowest grades from 2½d. to 4d. per pound. If the tobacco from the antipodes turns out satisfactory, the prices realized will no doubt be found equally so."

SELECTED FORMULÆ.

Inking Typewriter Ribbons.—Take vaseline (petrolatum) of high boiling point, melt it on a water bath or slow fire, and incorporate by constant stirring as much lamp or powdered drop black as it will take up without becoming granular. If the vaseline remains in excess, the print is liable to have a greasy outline; if the color is in excess, the print will not be clear. Remove the mixture from the fire, and while it is cooling mix equal parts of petroleum benzine and rectified oil of turpentine, in which dissolve the fatty ink, introduced in small portions, by constant agitation. The volatile solvents should be in such quantity that the fluid ink is of the consistence of fresh oil paint. One secret of success lies in the proper application of the ink to the ribbon. Wind the ribbon on a piece of cardboard, spread on a table several layers of newspaper, then unwind the ribbon in such lengths as may be most convenient, and lay it flat on the paper. Apply the ink, after agitation, by means of a soft brush, and rub it well into the interstices of the ribbon with a tooth brush. Hardly any ink should remain visible on the surface. For colored inks use Prussian blue, red lead, etc., and especially the aniline colors.

Aniline black ½ ounce.
Pure alcohol 15 "
Concentrated glycerine 15 "

Dissolve the aniline black in the alcohol, and add the glycerine. Ink as before. The aniline inks containing glycerine are copying inks.

To Remove Oil and Grease Spots from Colored Leather.—One of the most annoying things in shoemaking is grease spots on colored leather, and the numerous inquiries as to how to remove them show that they occur only too often. We, therefore, believe the trade will learn with interest that, after innumerable experiments, costing much time and money, a means has been found for removing grease spots from leather without changing its color.

Any one who has tried to clean spotted leather by known processes will have become convinced that they are all defective. The use of chalk is complicated, and requires a great deal of time. Spirits of wine injures the color; benzine does the same, with the addition that it attacks at the same time the fatty substances necessary to preserve the fiber of the leather, thus being doubly injurious. Applying hot iron over the grease spot, after covering it with blotting paper, offers no sure result. So other means had to be sought for. Thus it was that finally a solution of gutta percha was tried, with surprising results.

It is true that at first some failures were recorded, but these were due to the employment of benzine as a solvent. There was no doubt that the solution of gutta percha in benzine would remove the grease; but all around the place where the mixture had been applied, a dark circle still remained to show the spot.

Finally, a solution of gutta percha was prepared by pouring carbon bisulphide into a bottle of suitable size, containing the non-vulcanized gum, and allowing it to stand about twenty-four hours. The solution is moderately liquid, and, after shaking it actively several times more, rubber is gradually added, until the solution becomes of gelatinous consistency. This mixture was applied in suitable quantity to colored leather which had been smeared in fish oil, and allowed to dry two or three hours. The subsequent operation consists merely in removing the coat of gum from the surface of the leather—that is, rubbing it with the fingers, and rolling it off the surface.

The color is not injured in the least by the sulphuret of carbon; only those leathers on which a dressing containing starch has been used look a little lighter in color, but the better class of leathers are not so dressed. As to the dried gum, it can be redissolved in sulphuret of carbon and used over again.

The new process consists, then, simply of the application of a very stiff solution of gutta percha in carbon bisulphide, forming a coating of from one-fourth to one-half centimeter thick over the grease spot, leaving it to dry; and afterward removing it. As the gum can be used over and over again, and only the carbon bisulphide has to be supplied, the process is very economical.—From Neue Wiener Schuhmacher-Zeitung.

Blue-Black Ink.

Aleppo nut galls "blue" 4½ ounces.
Cloves bruised 12 "
Cold water 40 "
Ferrous sulphate (purified crystals) 1½ "
Sulphuric acid 35 drops.
Sulphate of indigo ¼ ounce.

Macerate the nut galls and cloves in the water during a fortnight; then press and strain through a cloth filter, add the ferrous sulphate previously powdered, dissolve, and add the acid and indigo solution. Shake or stir the mixture well; then set it aside for a week, and filter it. The nut galls should be free from insect perforations. The sulphate of indigo should be used in the form of a thinish paste, neutral or nearly so.—Pharmaceutical Era.

A Means of Polishing Machinery.—The chemical laboratory of the industrial museum of Batavia recommends a mixture of—

Oil of turpentine 15 parts.
Oil of stearine 25 "
Jeweler's red 25 "
Animal charcoal, of superior quality 45 "

Alcohol is added to that mixture in such a quantity as to render it almost liquid, then by means of a brush it is put on those parts that are to be polished. When the alcohol has dried, the remaining cover is rubbed with a mixture of 45 parts animal charcoal and 25 parts jeweler's red. The rubbed parts will become quite clean and bright.

Solution for Removing Nitrate of Silver Spots.

Bichloride of mercury 5.0 grammes.
Ammonium chloride 5.0 "
Distilled water 40.0 "

Apply the mixture to the spots with a cloth, then rub. This removes almost instantaneously even ancient stains on linen, cotton or wool. Skin stains thus treated become whitish yellow and soon disappear.—Mutsch. f. Prakt. Derm.

THE ELECTRIC TRANSPORTATION SYSTEM OF FAIRMOUNT PARK, PHILADELPHIA.

ONE of the most interesting and novel electric lines in this country is that recently installed within the confines of Fairmount Park, Philadelphia. This attractive park is the largest and most important of the public pleasure resorts in Philadelphia, and in fact is the largest public city park in the world and covers 2,740 acres. It is attractively located on both sides of the Schuylkill River, which divides West Philadelphia from the older part of the city, and is quite accessible from the latter, the entrance at Twenty-fifth and Spring Garden Streets being only about a mile in a direct line from the City Hall. The park is noted for natural attractions and artificial improvements, as well as for its extent, in all of which it ranks among the first in the world among similar undertakings.

Although traversed by many fine carriage drives and walks, the very size of the park, which, like the city, was laid out with exceedingly generous proportions, has made many portions of it inaccessible to all except sturdy pedestrians or those who could drive or ride to the points farthest distant from the entrances. In this way many of the most beautiful localities within its borders have been practically unknown to the large mass of citizens; but the proposals which have been made from time to time heretofore to open these portions to visitors by means of a railway have always been defeated, owing to the fear that the construction of a transportation system would destroy or seriously injure the natural attractiveness of the park. The subject was again taken up, however, several years ago, and plans were prepared showing how an electric line making a circuit in the park could be built without a great destruction of the natural scenery, and after much debate among the park commissioners a franchise for such a line was finally granted the Fairmount Park Transportation Company. The result is so at variance with the popular idea that a railroad

ways, the company has constructed a number of viaducts, stone arches and iron bridges, the total number of which is twenty, including a bridge over the Schuylkill River, which is 237 ft. long. This bridge has a double track for the railway, a 40 ft. wide carriage drive and a 12 ft. wide sidewalk. The height from the drive to low water is 80 ft. This bridge has four river arched spans each 208 ft. long.

The rolling stock consists of sixty cars, ten of which are closed motor cars. Of the fifty open cars, twenty are fitted with motors and the remainder are trailers. All the cars are of unusual width, being 7 ft. 10 in. in the clear at the seats. The gage is 5 ft. 2½ in. The closed cars have 32 ft. bodies and are 42 ft. over all. They are 8 ft. 9½ in. wide at the posts. These cars seat forty-eight passengers in cross seats, which are 35 in. long and have a 21 in. aisle between them.

The open cars were also specially designed for the service and differ essentially from other cars of a similar type. In length they measure 47 ft. over the crown pieces or 38 ft. at the corner posts. The width over the posts is 8 ft. 10 in. This gives a long seat which accommodates six persons comfortably. As the seats are spaced 3 ft. in the clear, ample room is given those entering or leaving a seat. The spaces are the same as those in the Broadway cars in New York City, and in the case of a crowd there is ample standing room for a row of people in front of those who are sitting. There are eight reversible seats and four with stationary backs, giving a seating capacity of seventy-two.

The cars are mounted upon 27-B trucks, a modified form of the "Perfect truck" of the same firm. These trucks are equalized, and have a swing motion which is cushioned by means of springs within the swinging links. This feature makes them very easy and steady on curves even when going at a high rate of speed. A long elliptic spring on each side is so arranged as to take the place of the equalizer.

They give a short wheel base, bring the body of the car low and do not kick up under the action of brakes.

which there are a large number, the trolley wire is secured in heavy yellow pine troughs with standard cone and cone barn hangers. All curve work is of exceptionally heavy construction, owing to the use of heavy No. 0000 trolley wire and the constant traffic.

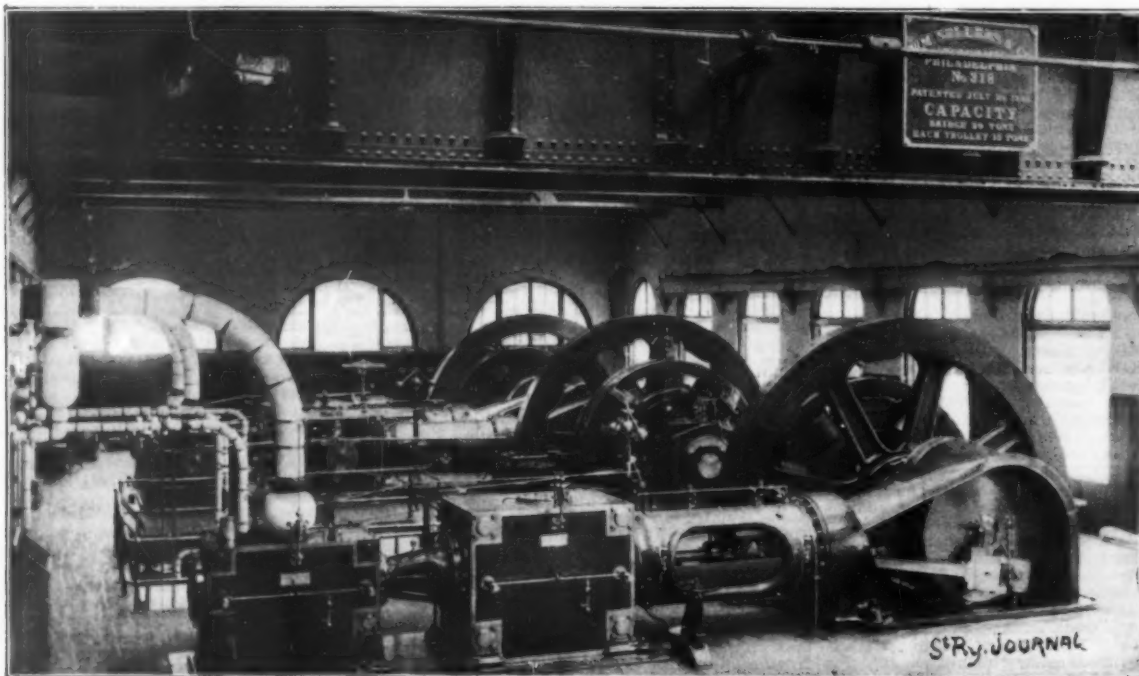
The feeders are underground and are laid in 2½ in. Williamsport creosoted wooden ducts. Roebbling paper covered feeders are used. This feeder system runs across a number of valleys containing streams of water and many of the manholes are 20 ft. deep. The contractors for the overhead and underground systems were Pepper & Register. Mayer & Englund supplied the overhead appliances.

A short distance below the car house is situated the engine and boiler house. This building was designed by Axel H. Engstrom and Edw. B. Ives, and is almost much below the surrounding level. The stack is only as high as the roof of the house itself, and from a little distance the building is entirely hidden from sight by the tree-covered banks.

The engine room is 156 ft. by 55 ft. in size, and the boiler room of the same length and 36 ft. wide. A spur from the adjacent railroad is carried close to the south wall of the boiler room and passes over coal vaults, the coal being dumped into the vaults by means of chutes. The station has sufficient storage capacity for one month's supply of coal.

At present there are installed three tandem compound condensing Corliss engines, furnished by Robert Wetherill & Company. There is room in the station for two more engines. The engine foundations are of brick and of unusually large proportions. Each foundation rests upon a concrete bed. This bed of concrete is 24 in. in thickness. The engines have cylinders 20 in. and 36 in. by 48 in. in size, and each makes 90 revolutions per minute.

The flywheel is 20 ft. in diameter and weighs 40 tons. It is made in sections, an arm being cast with each rim section. The rim segments are tied together by heavy wrought iron links. Each engine is directly connected



ENGINES AND GENERATORS—FAIRMOUNT PARK POWER STATION.

line, and particularly a trolley road, is necessarily conspicuous and must detract in a park from the natural scenery, that a description of the methods by which the results are reached will be of interest.

On reaching the park the visitor's first surprise is to find the cars standing on the edge of the lawn with almost nothing suggesting a railway in sight. While the usual overhead work is in place, it is not conspicuous, owing to the openness of its surroundings, while on the ground only two rail heads are seen stretching away through the grass. The space between the rails is completely filled in and sown with grass. The element of danger is eliminated by avoiding, from one end of the park to the other, every grade crossing of even a foot path. The line dips sharply under many of the carriage ways; it winds along valleys, clings to the hillsides, follows up and down ravines, and is as utterly unobtrusive as two lines of iron could be on the landscape. Conforming so closely to the contour of the land, there are few embankments or cuttings that are even noticeable features in the landscape until one is close upon them. Even the power station and car house are hidden from sight, as will be described later.

The line has a length of 8¼ miles, along which stations are constructed at distances of about three-quarters of a mile apart, and at these stations only are passengers allowed to enter or leave the cars. The road being in the form of a loop, the cars run in one direction only. For short distances at the southern and eastern ends the tracks lie parallel, but for the remainder of the distance they are widely separated. The whole line is inclosed by a wire fence of twisted steel. The track is laid with 90 lb. T rail laid on yellow pine ties 6 in. x 8 in. x 8 ft. in size and spaced 2 ft. centers. The rails are bonded with the Brown plastic bond. All switches are of standard steam railroad pattern. As all banks and cuts are seeded with grass, they are of a different slope than is usual. Those on banks and cuts less than 10 ft. deep are proportioned as one to three, and on cuts or banks more than 10 ft. in depth the proportion is one to two.

In preventing grade crossings over drives and path-

This road tests the riding qualities of the cars most severely, as it is full of curves, many of them of quite short radius. Under these conditions the trucks are riding with remarkable ease and smoothness.

The electrical equipment consists of four motors to a car and electric brakes acting on all axles, on the trailer cars as well as the motor cars. The cars are equipped with G. E. 1,000 motors and controllers, specially manufactured for the Fairmount Park Transportation Company, controlling both motors and brakes. The operation of the road is protected with the Hall block signal system.

The overhead construction work of this line is one of the most substantial in the country and is of a peculiar nature, owing to the heavy traffic and the location of the road through a series of rock and clay cuts, over high earth embankments and through and over stone and iron viaducts.

Over 60 per cent. of the poles are set in solid rock and about 15 per cent. are of special lengths and construction, varying all the way from a 28 ft. pole, weighing 750 lb., to a pole 65 ft. long, weighing 2,800 lb. There are three standard weights of poles on the line—on straight track a 7 in. by 6 in. by 5 in. 28 ft. pole, weighing 750 lb.; for pull-offs and special strains a 1,000 lb. pole of same dimensions, and for special strains, at the end of the line, an 8 in. by 7 in. by 6 in. 28 ft. pole, weighing 1,800 lb. The poles are set in concrete 6 ft. deep, in 2 ft. diameter holes. On straight track, poles are spaced 100 ft. apart and on curves 50 ft. apart.

The span wires are ¾ in. diameter steel cable, insulated from poles by special heavy Macallan turnbuckles. The trolley wire is attached to the span wire through a special cap and cone insulator. The trolley wire is a No. 0000, and it is held in the insulators by soldered ears weighing a little over double the standard weight ear used on No. 00 construction work. The wire is spliced with heavy copper sleeves. All feeder taps are provided with 600 ampere single switches, heavy line brakes and General Electric Company's lightning arresters. On double track the trolley wires are cross connected every 1,000 ft. Under bridges, of

to a 500 kilowatt generator, furnished by the General Electric Company.

The boiler room at the present time contains six Berry boilers, built by Wetherill & Company, and space has been provided for the installation of two more. Each boiler is of the vertical type, occupies a floor space of 11 ft. by 11 ft. in size, and is rated at 250 horse power. The gases from the boilers pass to an overhead smoke flue leading to two sets of economizers, from which the waste gases are exhausted by a pair of exhaust fans discharging into a short steel stack 7 ft. in diameter. The economizers are so connected to the flues that one set receives the waste gases from the boilers at one end of the boiler room, while the other receives the waste gases from the other boilers. All of the waste gases, however, may be passed through either economizer. A single fan, 10 ft. in diameter and 4 ft. wide, driven by a direct connected engine, exhausts each economizer, and both fans discharge into a common stack. The fans and economizers were furnished by the American Economizers Company. The economizers have 256 pipes each. The sections are eight pipes wide and each pipe is ¼ in. in diameter and 9 ft. 4 in. long. Each economizer has a heating surface of 2,944 ft.

The exhaust steam from the engines passes into a 20 in. exhaust main located under the floor of the engine room. This main is divided into two sections by a 20 in. valve and each section has a pipe leading to a twin vertical air pump made by the George F. Blake Manufacturing Company, connected to a jet condenser. A branch from the exhaust pipe to the condenser 16 in. in size, and fitted with a relief valve, unites with the free exhaust from the other half of the system to form a 20 in. pipe leading to the atmosphere.

The steam cylinders of the air pump are 12 in. in diameter, and the bucket of the air pump, which is single acting, is 25 in. in diameter. Each has a stroke of 18 in. The injection water is taken from the adjacent Schuylkill River through a 16 in. pipe. These mains pass to the condensers in a trench between the two concrete beds underneath the engine foundations.

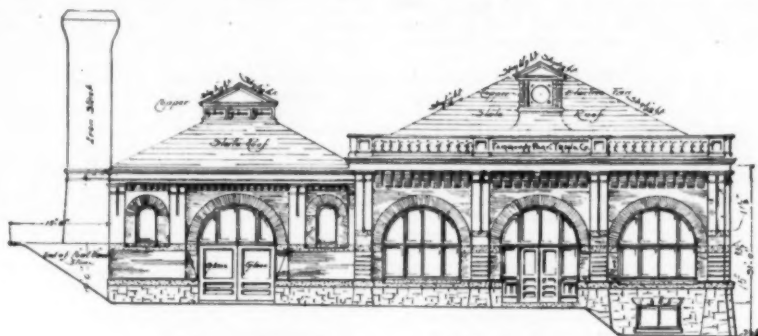
The discharge from both condensers is 16 in. in size, and leads back to the river.

All of the auxiliaries of the plant, such as the air pumps from the condensers, drip and feed pumps, fans, engines, etc., are supplied by branches from an auxiliary steam main supported from the wall of the engine room. The exhaust steam from all of these auxiliaries is collected into a 6 in. pipe and passed through a Berryman feedwater heater with 1,000 sq. ft. of heating surface from which the surplus exhaust steam passes into the free exhaust pipe from the main engines. The heater, however, may be by-passed if desired. The boiler feedwater may be taken either from the river or from the discharge from the condensers. The water, which is taken from the discharge from the condensers,

of which the heating wires are embedded in a non-conducting, incombustible compound. The oven is a box, so thoroughly heat insulated that the outside metal covering never reaches a temperature uncomfortable to the hand. The broiler is made of a corrugated metal surface, slightly tipped from the horizontal, with a drip groove at the lower edge for catching the meat juices. The flatirons are similar in construction to the stoves, the larger one having a low current switch, which enables the operator to control the heat.

In all these appliances the heating coils are so arranged that the energy is largely concentrated at useful points. They are also supplied with supports and bases which will not conduct heat.

The efficiencies of the two larger stoves were ob-



SOUTH ELEVATION OF POWER STATION.

is passed through a filter made to remove the oil in order that it may not enter the boilers.

The boiler feed pumps are two in number and the water is forced by them through the feedwater heater, where it is raised to about 200° temperature, and from the heater either directly to the boilers or through the fuel economizers as desired. The fuel economizer may also be by-passed if desired.

The cost up to date for the 8½ miles of line is estimated at \$2,000,000, including \$500,000 paid for the franchise. To earn returns on this investment a large traffic is, of course, necessary, as the fares are limited to five cents per passenger, independent of the length of ride. The traffic so far has been enormous, and points to a most successful financial return upon the investment. Thirty-five hundred passengers have been carried in one day, the maximum load in the station on this day being 3,400 amperes, while the running expenses were \$300.

We are indebted to The Street Railway Journal for cuts and particulars.

THE ECONOMY AND UTILITY OF ELECTRICAL COOKING APPARATUS.*

By JOHN PRICE JACKSON.

THE tests of electrical cooking apparatus detailed in this paper were made with the hope of obtaining a method of cooking that would be satisfactory with a minimum risk of fire. During the past winter a serious fire, which might readily have become disastrous, occurred in one of the buildings of the college with which the writer is connected, caused by the use of an alcohol stove. As this institution is lighted and furnished with power by electricity, it was naturally felt that such a danger should be avoided, if possible, by the use of electrical appliances. It was also desired to ascertain whether at least a portion of the cooking in-

tainied by heating two pounds of water to the boiling point and measuring the power supplied by a calibrated wattmeter. The cooking vessels used were ordinary stewing pans, with the bases nearly of the same size as the tops of the stoves. The efficiencies, considering the ratio between the amount of heat absorbed by the water and the amount received by the stoves, were:

For the larger or No. 1, 48.9 per cent.

For the next size, " 2, 43.1 "

These efficiencies could be increased by having the pans made to fit the stoves exactly, and still further by carefully covering the pans, lids and exposed portions of the stoves with a non-conductor of heat.

When it is desired to boil water, the best plan is to place an immersion coil in a properly heat-insulated pot; such an arrangement should give an efficiency of from 90 to 100 per cent. We unfortunately did not have such a coil at our disposal.

It was impossible to measure the cooking efficiency of the oven, but as it was merely warm on the outside after potatoes or bread had been baked and "done to a turn," the efficiency is high. In baking, the current was turned on and the oven allowed to heat for five minutes before the articles to be cooked were placed within, and the current was turned off from ten to twenty minutes before the baking was done, when the heat of the oven was sufficient to complete the operation. The broiler was manipulated in much the same manner, thus utilizing the greatest possible amount of heat. This electrical apparatus was used for several weeks in cooking most of the meals for a family of six.

The following table indicates the amount of cooking done for the first breakfast, dinner and supper respectively, and may be taken as a fair average of the whole period.

All costs have been estimated on the basis of 10 cents per kilowatt hour, the average rate charged for residence electrical supply in a near-by town. The foods

DINNER.			
Time.	Utensils.	Food.	Watts.
10.51	No. 0, on	Beef, roast...	1610
10.55		Potatoes....	
11.35		Pie	
11.46	1, on	Asparagus...	1960
12.05	0, off		
12.05	2, on	Coffee	1180
12.11	B, on	Toast for aspar...	2200
12.29	1, off		1835
12.32	B, off		
12.32	2, off		
Kilowatt hours, 2.98		Cost, 29.8 cents.	

SUPPER.			
4.59	No. 1, on	Cocoa	630
5.15	2, on	Potato cakes....	1010
5.16	B, on	Omelet	2100
5.22	2, off		1700
5.26	B, off		
5.26	2, on		1130
5.43	2, off		640
5.44	1, off		
Kilowatt hours, 8.39		Cost, 8.39 cents.	

Four pies can be baked in the oven at an expenditure of 0.62 kilowatt hour and a cost 6.2 cents or 2.05 cents per pie. Two large loaves of bread were baked with the current on the oven 50 minutes, at an expenditure of 1.22 kilowatt hours, a cost of 12.2 cents or 6.1 cents per loaf. Four rather small-sized loaves could have been baked as readily. Biscuits with about the same expenditure of energy as in the case of pies. The broiler utilized about the same amount of energy for all kinds of meat as indicated in the table. The cost of soup sufficient for the family was about 4.5 cents.

The result of the whole series of meals was a cost for electricity of 13.1 cents per meal. The heating of water for washing the dishes took an additional 0.35 of a kilowatt hour per meal, which raises the cost to 16.6 cents per meal.

To determine the relative cost of cooking with electricity and coal, the same foods were cooked on the No. 8 Othello coal stove ordinarily used by the family. The coal was carefully weighed. The results gave an average of 12.6 pounds per meal, which at \$5 per ton gives a cost of 3.15 cents per meal.

The results show the cost of cooking by coal to be about 19 per cent. of the cost of cooking by electricity.

Ironing was done for the same household a number of times. The heavy articles were done with the large iron; while for fancy dresses and light articles the small iron was used. The average time taken was four hours, and the expenditure of energy in kilowatt hours was 2.27. This made the cost of the ironing 22.7 cents.

An equal number of tests was made using the coal range, the fuel being carefully weighed. For the same sized wash, the ironing took five hours, at a cost of 12.25 cents. This shows the cost of energy by the use of coal to be 54 per cent. of that by electricity.

The results of the cooking tests seem to indicate that for the usual cooking of a family for the whole year the expense would be larger than would be ordinarily acceptable, notwithstanding the great advantages in other respects. However, in the following classes the utility of electrical cooking utensils should be great:

1. For light housekeeping, such as is practiced in small city apartments, and in many larger houses during the summer months, no other method presents so many desirable features. The dirt of coal and ashes, disagreeable gases and abnormal temperature due to a coal stove are entirely avoided. For such housekeeping a disk stove using 500 or 600 watts and a broiler using about 1,200 watts would be sufficient for a small family and would cost from \$30 to \$30. A teakettle or immersion coil might be added at a cost of from \$6 to \$10.

A special pair of wires would of necessity have to be run into the cooking room from the house or apartment supply mains. The latter would ordinarily warrant the extra call that would be made on them in this way. For similar purposes coal oil, gas or gasoline are frequently used, but with the inherent disadvantages of greater heat in the room, offensive odors, comparative uncleanness and danger.

2. This form of cooking apparatus could be used with facility in boarding houses and restaurants for purposes that require an even temperature, such as is needed in baking griddle cakes, boiling eggs, etc.

3. Where electricity is available, nothing could be more convenient than a small electrical stove, requiring 300 or 400 watts, for the many uses to which at present the alcohol flame is put, such as the afternoon tea-



TYPICAL PASSENGER STATION—FAIRMOUNT PARK.



ENTRANCE TO ONE OF THE ARCHES.

the woman's department of the college could not be done satisfactorily by electricity.

To determine these points, I procured from the American Electrical Heating Corporation, of Boston, through the courtesy of Mr. J. E. Sayles, the following pieces of apparatus:

One oven, 13' x 9' x 18", having three heats, 3, 10 and 17 amperes respectively.

Three stoves of 2, 4 and 5 amperes respectively.

Two flatirons of 1.5 and 6 amperes capacity.

One broiler of 12 amperes capacity.

One curling iron of ½ ampere capacity.

The pressure used by these is 110 volts.

The stoves are round disks of iron, on the under side

were not measured, as it was believed more desirable to determine whether in a long period of cooking the apparatus would prove satisfactory for a family of given size.

The largest stove is designated No. 1; the next size, No. 2; the third size, No. 3; the broiler, B, and the oven, O.

BREAKFAST.			
Time.	Utensils.	Food.	Watts.
6.55	No. 1, on	Rolled oats	844
6.55	2, on	Coffee	
7.45	1, off		
7.45	B, on	Beefsteak	1500
7.55	2, off		1155
8.05	B, off		
Kilowatt hours, 1.355		Cost, 11.46 cents.	

* A paper presented at the fourteenth general meeting of the American Institute of Electrical Engineers, Eliot, Me., July 28, 1897.

kettle, chafing dish, toaster, etc. This use of alcohol is most unsafe as regards danger from fire, and could well be discarded for electricity, which is absolutely safe when properly installed, as well as being more convenient and better in other respects.

4. In the shop, the glue pot, solder pot, brazing iron, etc., can be heated advantageously by electricity, and one of the most gratifying consequences of our experiments has been the decision to put such an equipment in our college shops.

5. The test of the electrical flatirons showed them to be more economical than the old form, when the saving of labor is taken into account. Not only is there a saving in time, but the severity of labor is much lessened. Our experience is that a laundress who has used an electrical iron would be exceedingly unwilling to go back to the old form.

A small flatiron of two or three amperes attached to the ordinary lighting fixture in a dressing room is a great convenience; and with the electric teakettle and curling iron is destined to become essential in the modern home.

Concerning the question whether the use of electricity had proved satisfactory in its operations in the cooking tests described, the housekeeper in charge said: "The instruments were excellent in every respect. We were able to cook more rapidly, to keep the heat at just the right point, and could readily prevent over-cooking or under-cooking. While we were using electricity every dish was perfect. When I think of these advantages and of the cleanliness and convenience of the utensils, I sincerely hope that some of them at least may be retained in the house permanently."

The general results of the tests were of such a nature that the writer is warranted in the belief that if central station managers would more generally introduce exhibition equipments of these domestic utensils, a new call on their station capacity would develop, of which the larger proportion would be during the light load periods.

I wish to acknowledge my indebtedness to Mr. Rudolph F. Kelker, of Harrisburg, Pa., for his valuable aid in carrying out the work briefly described above.

THE BEHAVIOR OF ARGON IN X RAY TUBES.*

IN continuation of some experiments made by Prof. Callendar in the early part of 1896, the authors have studied the behavior of argon in X ray tubes of various types. The phenomena presented by a tube filled with carefully dried and purified argon are in many respects peculiar, as compared with those presented by other gases under similar conditions.

In the early experiments above mentioned it had been our custom to keep the X ray tube connected with the pump, which was used as a reservoir of dry air during long exposures. The gas, which was absorbed by the working of the tube at a high vacuum and a long equivalent spark gap, was restored from time to time, as the vacuum became too high, by letting a little air in from the pump by means of a convenient tap. In this manner it was possible to operate the tube at a very high rate of efficiency for two hours or more at a time. These long exposures were required for some experiments on the velocity of the X rays, which have been described in a communication to the Canadian Royal Society, May, 1896.

It was noticed on several occasions, after one of these long exposures, that there was considerable blackening and sputtering of the electrodes, and also that the pressure of the air in the tube had increased considerably above the degree of vacuum required for the production of X rays when the tube was first exhausted. After allowing the tube to rest for a few hours, although there was very little increase in the pressure, it was also observed that no cathode rays were produced until the discharge had been passed for some time. It appeared probable that some of these effects, which are recorded in the paper above mentioned, were due to the accumulation of argon in the tube. The spectral lines of that gas were on some occasions faintly discernible in parts of the tube, but no systematic spectroscopic observations were taken.

In making further investigations on the behavior of argon, we hoped to find that, owing to its natural inertness, the vacuum would be of a very permanent type as compared with other gases. We also hoped that its monatomic character would afford features of interest.

For the preparation and purification of the argon used in these experiments, the Cavendish spark method was adopted, as described by Rayleigh and Ramsay. For this purpose a special transformer was constructed, the primary and secondary of which were wound on different parts of the core. The primary was connected to the 100 volt lighting circuit. The secondary gave 10,000 volts on open circuit, available for starting the arc, but the voltage on the arc when running was only 2,000. The secondary could be short circuited, owing to the arrangement of the winding, without materially increasing the current or running any risk of burning up the coil. The apparatus could thus be left running safely by itself day and night without wasting any power on resistances. After concentrating the argon to about 60 or 70 per cent. in the flask it was further purified in a test tube apparatus, constructed so as to contain the minimum of liquid. The excess of oxygen was sparked off with hydrogen and the residue removed by absorption with alkaline pyrogallate. The argon thus purified was kept in a bulb containing P_2O_5 .

In the first set of trials of this argon in X ray tubes, a Fleuss mechanical pump was used, which permitted very rapid exhaustion of the tubes, but had no arrangement for measuring the high vacua. The vacuum was estimated in these cases by the appearance of the tube and the width of the dark space.

The first tube tried had two aluminum electrodes, and had been lying open to the air for some time previously. It was exhausted and washed out two or three times with dry argon, and then sealed off at a good X ray vacuum. Each operation occupied only two or three minutes, and the vacuum has since that

date deteriorated slightly, probably owing to insufficient removal of residual gas from the electrodes, but it still gives sufficient light to see the bones of the hand. The tube during exhaustion presented exactly the same appearances, except in color and spectrum, as if it had been filled with air.

The second tube had been worked up to a sparkless vacuum some weeks previously and had been frequently renovated by heating. It had an aluminum cathode and a platinum anode. It was connected to the pump and exhausted as soon as possible after opening. It was then filled with dry argon up to a pressure of one-fifth millimeter and exhausted to an X ray vacuum five times in succession. The glow on the cathode inside the dark space showed the F line of hydrogen and also the C line more faintly. These lines probably indicated the elimination of hydrogen from the electrodes, especially the cathode, as they became fainter with each repetition of the process of washing out.

At the sixth filling of the tube the pump was worked for ten strokes only. The cathode then began to sputter and blacken the tube and the argon was apparently absorbed, as the discharge refused to pass in three minutes. Fresh argon was again admitted, the coil was left running, but the pump was not worked at all. The spectroscopic tube this time showed only blue argon without any trace of hydrogen. The concave aluminum cathode sputtered violently and partly melted down. In less than two minutes the discharge refused to pass through the tube, which was then sealed off.

The coil used in these experiments was a very small one, which gave a two inch spark with difficulty when running on a large eight volt battery.

The next tube upon which we experimented was a double focus tube, containing two aluminum cathodes and a platinum anticathode. This was washed out with argon and exhausted eight times with the two inch spark coil running all the time. The direction of the discharge was frequently reversed, but no trace of absorption could be observed. The argon lines always disappeared and the hydrogen lines, especially F, became faintly visible inside the cathode as the tube approached an X ray vacuum. The tube at each exhaustion gave fairly bright X rays and showed no blackening or sputtering. The hydrogen lines showed more brightly close to the cathode than in the body of the tube, where the argon lines were most conspicuous. The hydrogen appeared, in fact, to be coming out of the metal. The glass walls of the tube were in a very dry state, as it had been previously heated and exhausted.

Finding that we could not get rid of the residual hydrogen with the coil, we had resort to the alternating current, which we had previously found very effective in tubes with double electrodes. It appears that the elimination of hydrogen takes place chiefly, if not entirely, at the cathode. With the first application of the alternating current, the hydrogen lines showed extremely bright. The tube was then exhausted. In fifty strokes the discharge refused to pass. On refilling with argon to a pressure of one-tenth of a millimeter, the blue glow inside the dark space showed only argon and no hydrogen. The pump on this occasion was not worked at all, but the gas apparently was absorbed, and the discharge refused to pass in about three minutes. There was some sputtering of the electrodes and blackening of the tube, but the aluminum, though blistered, was not melted. The experiment was repeated twice with the same results. On reconnecting the tube to the two inch spark coil, the same absorption was observable, but less rapid. The electrodes were larger and were less heated than in the case of the first tube.

We concluded from these and similar observations, of which the above may be taken as a sample: (1) That the hydrogen occluded in the cathode played the part of carrier of the discharge from the metal to the gas. (2) That if there were sufficient occluded hydrogen, there would be little or no sputtering of the aluminum. (3) That when no hydrogen was present, the discharge was conveyed from the cathode by particles of the metal itself, which were capable of exciting fluorescence of the glass and of generating X rays wherever they impinged, behaving in fact as cathode rays. (4) That in X ray tubes, as usually exhausted, without excessive precautions for the drying of the gases and the complete removal of residual hydrogen from the electrodes, the residual gas was in most cases hydrogen or water vapor.

In order to test the behavior of other gases as compared with argon, similar experiments in the same tubes were made with dry air, hydrogen, and with water vapor.

With dry oxygen and nitrogen, the absorption of the gas was very rapid at a pressure of one-tenth of a millimeter, if the electrodes were sufficiently heated. Although hydrogen was not observable and was presumably absent, blackening of the tubes was very slight, and a much greater power could be applied than in the case of argon, without melting the electrodes.

With water vapor under the same conditions an X ray vacuum could not be obtained (owing probably to the slowness of diffusion), unless the tube were considerably heated, either with a flame or by means of an excessive current. On allowing the tubes to cool under these circumstances, the vacuum improved very greatly, owing to the absorption by the surface of the glass, and the discharge often refused to pass. Under steady conditions of running at a low temperature, there was no clear evidence of absorption of the water vapor, in spite of the drying tube on the pump.

With carefully dried hydrogen, under the same conditions, the process of exhausting the tubes with the mechanical pump was extremely rapid as compared with the other gases, owing to the greater velocity of diffusion of the lighter gas. With the smaller tubes, ten or twenty strokes were sufficient to give brilliant X rays, starting in each case with a pressure of half a millimeter to a millimeter. There was no marked absorption at any stage of the vacuum, and no trace of sputtering of the electrodes. We expected to find some evidence of absorption by the electrodes or the platinum anticathode, but it is possible that these became saturated with gas very rapidly at an early stage, and ceased to absorb gas at an X ray vacuum. We concluded that hydrogen was the most suitable gas to use in X ray tubes, but it is possible that helium,

being also a very light gas, might be equally good if its inert or monatomic character does not lead to the disintegration of the electrodes in the same manner as in the case of argon.

If the great resistance to the passage of the discharge from the cathode to the gas in the case of argon is dependent upon the monatomic nature of the gas, it might be expected that similar phenomena would be observed in the case of mercury. Some mercury vacuum tubes were therefore made in the form of inverted U tubes. The electrodes were liquid surfaces of mercury in each limb, to which connection was made by short pieces of platinum wire, which did not project above the surface of the mercury. These tubes were exhausted and boiled with an alternating discharge passing, until more than half the mercury had distilled over. They then presumably contained only mercury vapor. When cool, the two-inch spark discharge refused to pass at first, but if the tube were tilted for a moment, so as to expose the platinum wire, it appeared that sufficient gas was liberated to enable the discharge to pass without any difficulty. The tubes showed only the mercury spectrum. In the high resistance state, immediately after boiling, the cathode limb, with a larger spark coil, showed brilliant fluorescence and feeble X rays. We concluded from these experiments that a very small trace of another gas was sufficient enormously to reduce the resistance of a mercury vapor tube, and that if the vapor could be obtained quite pure, it would possibly not conduct at all.

To verify more accurately the conditions of vacuum at which these phenomena occurred, the whole apparatus was subsequently connected to an automatic Sprengel mercury pump to which a McLeod gage was attached. The pump and all its connections were carefully tested for leakage, and the drying tube was filled with fresh P_2O_5 . We had found in previous experiments of a similar character, made two or three years previously, that sulphuric acid, however carefully prepared, gave off appreciable quantities of water vapor, which would have been quite sufficient to vitiate these results.

Using a large coil and a slow mercury break, to avoid overheating the tubes, we found that fairly efficient X rays were obtained in most of the tubes at an average vacuum of 0.006 millimeter, if the tubes were exhausted in the ordinary way without taking special pains to remove the hydrogen. The H lines always showed faintly in the cathode light before this vacuum was reached. After using an alternating discharge to heat the electrodes, and carefully washing out the hydrogen as far as possible with argon, we found that the pressure corresponding to an X ray vacuum gradually increased up to 0.030 millimeter. Before letting the argon into the tube it was allowed to remain ten or fifteen minutes in contact with the fresh P_2O_5 . On omitting this precaution and admitting the argon direct from a bulb containing an old sample of P_2O_5 , which was beginning to deliquesce on the surface, it was necessary to raise the vacuum to 0.015 millimeter before X rays were produced. On the other hand, the sudden addition of dry argon at this stage up to a pressure of 0.029 produced no change in the appearance of the tube. It is probable that we never succeeded entirely in eliminating the residual hydrogen, but we concluded from these and similar experiments that the presence of the argon by itself had little, if any, effect on the production of X rays, since the amount present in the tube could be varied within wide limits.

We next endeavored to ascertain at what degree of vacuum the apparent absorption of the argon previously observed could be produced. For this purpose we used two tubes of the double-focus pattern, and an alternating discharge. Taking the first tube slightly damp from the blowpipe, we exhausted it to one-fifth millimeter vacuum with the mechanical pump. The discharge was then turned on and adjusted to heat the tube and electrodes as much as possible with safety, and the pump was not further worked. Under these conditions the remaining water vapor was rapidly expelled and absorbed by the P_2O_5 , the tube soon showed a brilliant hydrogen spectrum followed by green fluorescence, the anticathode became red hot, then cooled, and in fifteen minutes the discharge (20,000 volts) refused to pass. The tube was not appreciably blackened. On connecting to the direct current discharge, it gave brilliant X rays. This case is interesting as showing that a very good vacuum may be obtained in these cases by simple absorption.

Dry argon was then admitted into the tube up to a pressure of 0.160 millimeter. At this pressure, in tubes three inches in diameter, with the direct or alternating current, the tube was filled with blue light, and gave a spectrum which was verified to be that of blue-argon, without any visible trace of hydrogen or nitrogen. After running the direct and alternating current through the tube for half an hour, the tube became very black, but there was no change in the pressure as measured by the gage. It should be remarked that in measuring these high vacua, the pump was usually stopped to allow time for the equalization of the pressure throughout the apparatus. The alternating current in the primary of the coil was only 2.5 amperes with argon, whereas 4 amperes had been used with air. The latter current, if used with argon, would have melted up the cathodes. Finding no absorption at this pressure, the pump was started to run very slowly, and the same alternating discharge was continued. The sputtering of the electrodes rapidly increased, and at a vacuum of about one-tenth of a millimeter the upper electrode suddenly melted off. Another tube was then tried but met with a similar fate at the same degree of vacuum. The failure was so sudden that it was difficult to control the current in time. If the argon is actually absorbed, it is clear that the phenomenon depends upon very special conditions of temperature and discharge. It is possible that the absorption is only apparent, and corresponds to a very sudden increase of resistance to the discharge at a particular degree of vacuum, such as occurs in an ordinary X ray tube when the boundary of the dark space reaches the anticathode. With greater care, it may be possible to decide this point, but an unfortunate accident to our water mains prevented further investigations at the time. It is clear, however, that the behavior of argon is peculiar, and it seems probable that most of the ordinary cathode ray phenomena are due to residual hydrogen.—Nature.

* By Prof. H. L. Callendar, F.R.S., and Mr. N. N. Evans, Lecturer in Chemistry, McGill University, Montreal. (Read before Section A of the British Association, at Toronto.)

CHEMICAL PROCESSES IN A GAS PLANT.*

It is a remarkable fact from the standpoint of the chemist that chemistry occupied itself for many years but little with this important branch of the chemical industry, and even to-day only the largest gas plants in Germany employ a chemist. Yet the gas plant offers to the chemist a wide field of activity, beginning with the purchase of coal and reaching to the selection of burners for the street lamps. The manufacture of illuminating gas, as is well known, has not become any simpler during the last two decades. The purifying methods, it is true, have remained the same in principle, but the apparatus has grown more complicated. This is due to the desire to obtain the greatest results on small areas. In the selection of the apparatus of a new gas plant, the voice of the chemist should be heard, for he understands to judge its effect, while the engineer should naturally occupy himself with the mechanical side of it only. Thus it may happen that the engineer thinks an apparatus good, while the chemist declares it bad.

The work of the chemist in a gas plant may be divided into two parts, namely, in the control of the finished gas, and laboratory work for the purpose of the most profitable production and utilization of the principal product as well as the by-products. As regards the control of the gas, this extends, in the first place, to its illuminating power. In Hamburg a 17 candle gas has to be furnished, which is measured in an Argand burner with a Bunsen photometer. This is done in four photometer rooms at the gas works and two in the city, in order to supply the consumers with as uniform a gas as possible, for it is known that from good coal good and also bad gas can be produced, depending upon the temperature of the retort ovens. In small plants, with a few ovens, this is quickly noticed; but in large plants it is less noticeable, as with many ovens there are always a few which do not come up fully to requirements. In the Hamburg gas works small retorts are in use, the charges ranging from 300 to 500 pounds. All attempts to produce good illuminating gas in large chambers or ovens after the pattern of those used in the coke industry have failed.

The second point to be watched by the chemist is the sulphur contents of the gas furnished. It is known that the gas must be freed from the last trace of sulphuretted hydrogen. Sulphur contents in another form, however, are unavoidable, namely, sulphocarbon and sulphurous organic substances. By their combustion in the flame sulphurous acid and, according to conditions, some sulphuric acid are produced. Formerly there was much complaint in Hamburg over the action of the products of combustion of the gas, which attacked metals, textiles, etc. This proved to be simply due to the use of highly sulphurous English coals without lime purification as practiced in England. Lately, since a chemist is employed, it is possible to reduce by the proper selection of coals the high sulphur contents considerably, and the London limit of 22 grains of sulphur to 100 cubic feet of gas is maintained. Concerning the formation of sulphocarbon, this, of course, takes place in the retort already. The sulphuretted hydrogen escapes together with the raw gas from the incandescent coal, and forms sulphocarbon with the latter. Highly sulphurous coal yields much sulphuretted hydrogen, and for this reason much sulphocarbon, yet compared with the sulphuretted hydrogen the quantity of sulphocarbon formed is always very small. Of less importance than that of sulphur is the other customary determination of carbonic acid and ammonium. The former is a remnant from the old lime purification, while now gas is purified by means of iron oxide, and the carbonic acid is left in the gas. Rather high contents of it can hardly be avoided. The London standard for ammonia is 4 grains to 100 cubic feet, but in gas produced by good apparatus seldom more than a trace can be found. Only in works where the apparatus is overburdened it is possible to bring more ammonium into the gas. It is well to determine the heating power of the gas by the Junker calorimeter in order to render it in this respect as uniform as possible. The most careful gas inspection is without doubt practiced in London, where the gas is examined photometrically three times a day at 14 stations, by 22 chemists, who have to analyze it also on sulphur and ammonium.

DETERMINATION OF SULPHUR IN COAL†

In the method proposed by Fischer, 1 gramme of coal is placed in a combustion tube containing asbestos or pumice, and is consumed in a current of oxygen. The products of combustion are passed through a washing apparatus containing bromine dissolved in hydrochloric acid, whereby the sulphur dioxide is oxidized and can be estimated as sulphuric acid by precipitation with barium chloride and weighing. To shorten the operation, Fischer also proposed to oxidize the sulphur dioxide by means of hydrogen peroxide and then determine the resulting sulphuric acid volumetrically, by titration with an alkali. This method is considered by the author as lacking precision, five tests performed by him on one and the same coal having yielded appreciably different results. He therefore proposes to modify the method by dispensing with the asbestos (or pumice), which retains a notable quantity of the sulphuric acid—probably in the condition of sulphates—and is very difficult to wash. He also suppresses the hydrogen peroxide, since this substance can rarely be obtained in a pure state, and moreover, by reason of its rapid decomposition, is liable to leave small amounts of sulphur dioxide unoxidized. The coal to be tested is inserted in a combustion tube, the posterior extremity of which is provided with a platinum spiral, and the oxygen is introduced through two pipes, debouching one in front and the other in rear of the capsule containing the coal. The products of combustion are led into a washing apparatus containing a titrated solution of caustic alkali, with a little methyl orange to act as indicator. This solution arrests the carbon dioxide, the sulphur dioxide and the sulphuric acid. When the combustion is terminated the washings of the combustion tube and platinum spiral are united with the alkali solution, and a freshly prepared solution of sodium peroxide, carefully titrated

by the aid of methyl orange, is added. The whole is then boiled, and when the whole of the hydrogen peroxide has been decomposed, the total residual alkalinity is determined by means of normal acid. This gives all the data necessary for the calculation of the sulphuric acid fixed, and consequently of the sulphur present in the coal. The results obtained are very accurate, a Donetz coal found by gravimetric analysis to contain 3.65 per cent. of sulphur, yielding by the above volumetric method 3.61, 3.73 and 3.67 per cent. in three separate tests.

MERCURY PUMPS.

MERCURY pumps are, as well known, of great utility in laboratories, but certain difficulties are often experienced in making them work well. It is, therefore, not superfluous to make known the latest improvements that have been introduced into these apparatuses.

M. Henriot, in recently presenting a new mercury pump to the French Academy of Sciences, recalled some of the inconveniences of the ordinary apparatus, such as leakages due to the cocks, and which the most careful lubrication fails to prevent, loss of time due to maneuvering of the cocks, and chances of breakages in consequence of rain strokes. The new pump does away with all such inconveniences, columns of mercury being substituted for cocks in its construction. No. 1 of Fig. 1 gives a general view of the apparatus, and Nos. 2 and 3 show the details.

To the lower part of the bulb, B, there is soldered a vertical tube, E, which descends and terminates at f. From the upper part of this same bulb there starts a capillary tube, G, which, curving around it, enters a mercury reservoir, M, situated beneath.

When the mercury descends from B, the air, coming from the orifice, f, enters it and produces a bubbling of the metal that ceases as soon as the limit of the vacuum is attained. When the mercury reascends into the bulb, B, the orifice, a, closes and the air is driven into the reservoir, M. It is the tubes, G and E, then, that replace the cocks.

The tube, E, presents at its upper part a bulb, F, de-

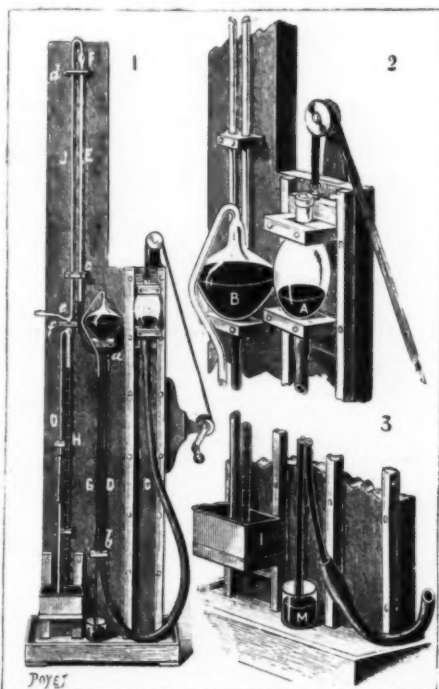


FIG. 1.—HENRIOT'S MERCURY PUMP.

signed to prevent projections of the mercury, which can never enter the apparatus in which a vacuum is forming, since the tube, J, is bent at the base at e, so that the mercury falls into the barometric tube, H.

This tube, H, is designed to measure the pressure in the apparatus. It is beveled off at the lower part so as to permit of the introduction of gas into the pump without any projection of the mercury taking place. From the bulb situated at the top of H starts a tube formed of two equal parts—one of glass and the other of rubber. The rubber one permits of forming a partial vacuum by means of a shower bellows. The operation finished, a movable reservoir, I, receives the tubes, O and H, both of which dip into the mercury. The rubber tube offers no opportunity for leakage, since, when a vacuum exists in the pump, it is completely filled with mercury.

A rod fixed to the base, and not represented in the figure, permits of holding a test glass in the reservoir, M. It will be seen that every detail has been carefully looked after in this pump, and that it is possible, in fact, to prevent all those leakages that are so apt to occur in the ordinary apparatus of the kind.

M. Carlos Alban has recently devised a pneumobarometric pump that permits of quickly obtaining a satisfactory vacuum within a given space.

This apparatus, which is represented in Fig. 2, consists of a bottle, E, with three tubulures (No. 1), and of a barometric tube, T, terminating at the top in a bulb, A, the details of which may be seen in No. 2. This bulb is provided with two cocks, R and S, and a pressure gage, N. The apparatus as a whole is fixed to a board that carries in the center, movable around a horizontal axis, a pivot support which may be placed upon the edge of a table. It is therefore possible for the apparatus to assume both a horizontal and vertical position.

In order to form a vacuum, dry and boiled mercury is introduced into the bottle, E, in sufficient quantity to allow the bulb and barometric tube, when the apparatus is placed horizontally, to become filled, and

enough mercury to remain to cover the lower aperture of the tube, T.

A vertical position is first given to the apparatus, in order to cause the mercury to descend, and after this it is gently brought to a horizontal one. The tube and then the bulb become filled with air, which escapes through the cock, S. The latter is then immediately closed. The apparatus is next placed in a vertical position again, the bulb remains empty, and upon opening the cock, R, it is possible to read upon the pressure gage the degree of vacuum obtained.

The cock, R, is afterward closed and the same operation is repeated until a vacuum of 1 or 2 mm. is formed. A bottle, O, placed at the upper extremity of the tube, is filled with phosphoric acid in order to absorb the aqueous vapor. An equilibrium is soon established in the two branches of the pressure gage, and we then have a barometer that may be utilized.

It is easy with this apparatus to repeat different vacuum experiments. The upper extremity of the tube, T, is connected by rubber with the apparatus in which the air is to be rarefied. Upon the cock, R, being opened, the air is sucked in and then introduced into the bulb, A. The cock, R, is then closed, the apparatus is placed in a horizontal position, and the air is driven to the exterior through the cock, S.

The apparatus, which is 5 ft. in height and 5 in. in width, is very easily maneuvered. With it, it takes but a very short time to perform various experiments, such as forming a vacuum in a Geissler tube, causing a jet of water to play in a vacuum, etc.—La Nature.

THE LOWER CONGO AND ITS PEOPLE.

FROM Banana to Boma the country is flat, and in the rainy season very swampy; the banks are thickly

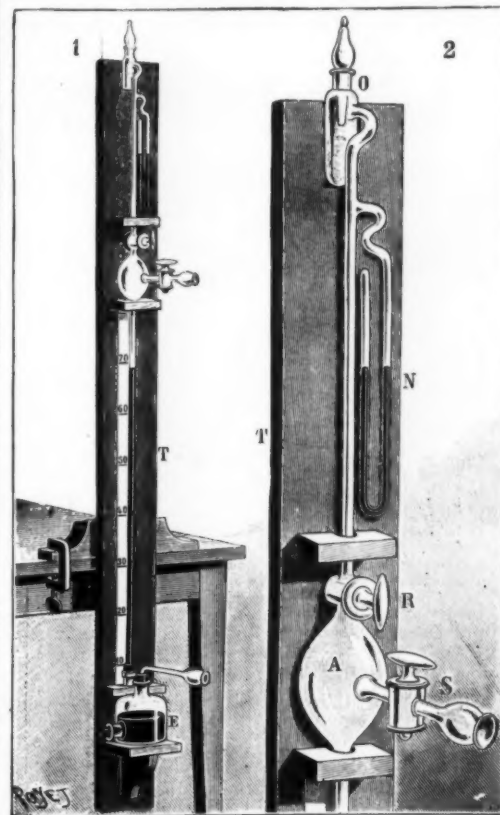


FIG. 2.—ALBAN'S PNEUMO-BAROMETRIC PUMP.

1. General view. 2. Details of the upper part.

wooded, but there is hardly any timber fit for export. Running east and west, and starting some twenty miles north of Banana there is a range of foot hills which extend to and beyond Stanley Pool to Bolobo, increasing in height and width as they approach the pool. This range is a continuation of the system which runs the entire length of the west and southwest coasts of Africa. Mr. R. Dorzey Mohun, who was appointed by the United States government to inquire into the condition of the Congo Free State, says that the land, in his opinion, is not suitable for agriculture, except on a small section near Banana Point. The only products of the soil shipped to Europe are palm kernels, palm oil and peanuts; and these are the only articles which are traded for by factories in the Lower Congo Valley. A few vegetables are grown in the gardens attached to each factory, but the soil has to be worked over and over again and watered two or three times a day in order to make them grow. No domestic animals exist among the natives, except a few goats and sheep, which command high prices. All the beehives, which are consumed by the railroad company's employees, are brought from Benguela and Mosamedes (on the southwest coast in Portuguese territory) by the Compagnie du Produit du Congo, which has established a large cattle rancho on the island of Mateba, below Boma. There are about 3,000 head there, and this herd is increasing. The tsetse fly does not exist, and the land is such that it could, no doubt, be made to yield profitably without an enormous sum being expended for irrigation. It is possible that on the hills to the north of Banana coffee might be grown advantageously, and cocoa on the lowlands; but the experiment has not yet been tried. The articles used for trade with the natives are red bandana handkerchiefs, gin, cloth, beads, machetes, old silk hats, colored parasols, cheap knives, flintlock muskets, powder, brass rods, crockeryware, tinware, old uniform coats, rum and watches. All these articles are speci-

* From an address by Dr. Leybold, before the general meeting of the German Chemical Society, at Hamburg.

† S. Langouet, Bulletin de la Société Physico-chimique Russe, xxiv, p. 344.

ally made for the trade, and the standard of value is a piece of handkerchief 24 feet long and 3 feet broad, and valued at about 2s. 6d. When the trader buys produce he gives out cards to the natives which are good each for a piece of handkerchief, and when the caravan has been bought out the natives come to the store and hand in their cards, where they can select what they want to the value of the cards held. As a rule they will not touch money, regarding it as useless; and this, of course, is a great advantage to the trader, who makes large profits in exchange for handkerchiefs, which probably cost him, landed on the Congo, duty paid, about ten pence each. The quantity of gin which comes into the Congo is enormous, but none of this ever reaches the interior of the state, as its importation has been prohibited. Very little ivory is bought in the Lower Congo, and this comes from a distance of not more than 100 miles north, south or east of Boma and Matadi. The large quantities of ivory which are being shipped from the Lower Congo come entirely from the Upper Congo. These shipments are increasing year by year, and Mr. Mohun gives it as his opinion that there is ivory enough in Central Africa to last at least another century. The natives of the Lower Congo belong to the Fiole tribe, but there is absolutely no king or chief among them. There are some so-called kings; but they have no authority whatever and are only kings because they call themselves so, on account of having a few more rods, bales of cloth or boxes of gin than their neighbors. Each village is independent of the other and it has its own head man, but no one recognizes the right of any one as their supreme ruler. Fetichism is largely practiced, and there is much quiet poisoning going on in the different villages by fetich doctors, but the hanging of several of these poisoners by the state has had a most salutary effect upon the remainder. They practice no religion whatever; they worship no idols, no fire, sun, or moon, or stars. If they wish to accomplish something, they propitiate a wooden fetich by hanging beads and gin bottles about its neck and murmuring some jargon to it. If something is stolen from them, they drive a nail into the fetich, perfectly convinced that in this manner they will succeed in killing the thief. Near Boma there is a native school of medicine, and the people who attend it for study are called "Imkimbas." During their term of study they must keep themselves whitewashed or painted white from head to foot. The natives are not particularly savage or vicious toward the white men. Only once in a while has the state found it necessary to send expeditions to enforce the laws. They have no arms of their own manufacture, and for hunting and war purposes use the trade flintlock musket. When a native dies and is buried, if he is a rich man, his body is wrapped in hundreds of yards of cloth, and many pounds of gunpowder are fired over his grave, which has been covered on the top with empty gin bottles, demijohns, basins and pitchers; at the head a large red, blue and white umbrella is stuck in the ground and hoisted. At night his friends and family indulge in a dance and drunken orgie. Their hair is usually dressed in some fantastic fashion; on their legs and arms they usually wear large brass rings, and around their necks a necklace of beads or tin tags from packages of tobacco. Their only clothing consists of a breech cloth, or piece of cloth tied round their loins; no head covering whatever. Their food consists principally of palm nuts, palm kernels, manioc and bananas; also rats, chickens and locusts. They are not a particularly strong or healthy people, their only strength lying in their legs; and it is very rare to meet one who has reached the age of fifty years, although many look a hundred years old. A great number die of pulmonary complaints.—*Journal of the Society of Arts.*

STATURE OF MEN OF GENIUS.

HAVLOCK ELLIS has been tabulating the measurements of height of 280 men of genius of all lands and ages. His idea is to find out whether the facts bear out the theory often stoutly urged that great men are apt to be short men. His conclusion is that they are apt to be either above or below the medium height. In the lists that he has compiled (Nineteenth Century, July), 113 of the men included fall into the list of tall men, 110 into the list of short men, and but 57 into the list of men of medium height. This medium height he places at from 5 feet 4 inches to 5 feet 9 inches. He does not claim accurate knowledge of the height of more than a small proportion of those whose names are included in the lists, classifying many by the mere description of tall or short as furnished by their contemporaries, precise figures not being obtainable. The results tally, however, with those derived from other sources, and furnish, Mr. Ellis thinks, a fairly safe basis for general conclusions. Among some of these conclusions, as drawn by him, we quote the following:

"It is clear that the belief in the small size of great men was not absolutely groundless. There is an abnormally large proportion of small 'great men.' It is mediocrity alone that genius seems to abhor. While among the ordinary population the vast majority of 68 per cent. was of middle height, among men of genius, so far as the present investigation goes, they are only 23 per cent., the tall being 41 per cent., instead of 16, and the short 37, instead of 16.

"The final result is, therefore, not that persons of extraordinary mental ability tend either to be taller or shorter than the average population, but rather that they tend to exhibit an unusual tendency to variation. Even in physical structure, men of genius present a characteristic which on other grounds we may take to be fundamental in them; they are manifestations of the variational tendency, of a physical and psychic variational diathesis. In a slight and elusive shape, a shape so elusive that it is rarely hereditary, the man of genius represents the same kind of phenomenon which, in organic nature generally, appears to have slowly built up the animated world we know. Just as the visible world is the outcome of the accumulated gross variations of plants and animals, so the world of tradition and culture is the outcome of the accumulated delicate variations of men of genius. The product is different, but it has been obtained by the same method.

"It would be interesting if we could trace in a more detailed and precise manner the factor of physical stature in the constitution of the genius variation, and ascertain its precise significance. This is still difficult. One or two points may be noted.

"It must be remembered that genius, however it may be defined, is certainly only an excessive development of characteristics which may be traced in much more rudimentary forms. It is thus not impossible to throw light on the subject of genius by investigating the peculiarities of physical stature generally, and the common intellectual accompaniments of underdevelopment and overdevelopment. The conclusion we have reached, that both tall and short individuals tend to predominate unduly among persons of genius, is confirmed and to some extent explained by observation of the general population. The observations so far made, indeed, are few, but so far as they go perfectly definite. Thus Mr. Bohannon—who, under the inspiration of Prof. Stanley Hall, has collected data concerning over one thousand abnormal children in the United States, dividing them into various groups according to the predominant abnormal character—finds that both tall children and short children are intellectually superior to children of medium height. The tall (except in cases of very excessive tallness, which may be regarded as pathological) showed their superiority both in general health and mental ability; at the same time they were notable for their sensitiveness, good nature, even temper and popularity with others. The small were less often healthy, and consequently were apt to be delicate, ugly or vicious; but when fairly healthy they tended to show very great activity both of body and mind.

"It would still remain to show the causes of this tendency; for it is scarcely possible to hold that the health and ability of the tall is due (as has apparently been suggested) to forced association with their elders in

legs coexisted with a small head. The typical stunted giant has a large head; and such stunting of the body has, indeed, a special tendency to produce large heads, and therefore doubtless those large brains which are usually associated with extraordinary intellectual power. It is a curious fact—as a distinguished anatomist the late Sir George Humphrey, remarked many years ago—that when from any cause the growth of the rest of the body is stunted, the head not only remains disproportionately large, but often becomes actually larger than in ordinary persons. 'Thus short persons and persons with imperfectly developed lower extremities are not uncommonly remarkable for the size of their heads, as though the expenditure of growing force being too great in one direction, other parts are ill cared for.' It may be added that the commonest type of dwarf possesses a proportionately large head and short legs.

"It would doubtless be an attractive task to attempt to trace the causes which lead genius to be associated at once with both abnormal extremes of stature. It must probably be found at an early period of embryonic development, when, as we know from the researches of Dareste and others, the causes of dwarfism may also be found, sometimes in arrest of growth resulting from precocious development. Here, however, it is enough to have ascertained the facts in a roughly approximate fashion. It need only be pointed out, in conclusion, that the result we have reached, although apparently new, is such a result as should have been expected. Geoffroy Saint-Hilaire long since, and Ranke more recently, have pointed out that both giants and dwarfs—the abnormally tall and the abnormally short—are usually



ECHINOCYSTIS LOBATA—HARDY ANNUAL.

youth, and quite absurd to hold that the activity and mental quickness of the small is due to the arrested development caused by forced association with their juniors. In both cases it seems probable that the primary cause is a greater vital activity, however we may ultimately have to define 'vital activity.' Among the tall such intensity of vital action has shown itself in unimpeded freedom; in the short it is impeded and forced into new channels by pathological or other causes. The latter case is perhaps the more interesting and complicated. An anthropometric examination of short men of genius would throw much light on this question. There are certainly at least two types of short men of genius: the slight, frail, but fairly symmetrical type (approaching what is called the true dwarf), and the type of the stunted giant (a type also to be found among dwarfs proper). The former are fairly symmetrical, but fragile; generally with little physical vigor or health, all their energy being concentrated in the brain. Kant was of this type. The stunted giants are usually more vigorous, but lacking in symmetry. Far from being delicately diminutive persons, they suggest tall persons who have been cut short below; in such the brain and viscera seem to flourish at the expense of the limbs, and while abnormal, they often have the good fortune to be robust both in mind and body. Lord Chesterfield was a man of this type, short for his size, thickset, 'with a head big enough for a Polyphemus.' Hartley Coleridge carried the same type to the verge of caricature, possessing a large head, a sturdy and ample form, with ridiculously small arms and legs, so that he was said to be 'indescribably elfish and grotesque.' Dryden—'Poet Squab'—was again of this type, as was William Godwin; in Keats the abnormally short

abnormal in other respects also. From the biological point of view we know nothing of 'genius,' what is so termed being simply an abnormal aptitude of brain function; so that among those variations and abnormalities which, as is already generally agreed, we find with unusual frequency among the very tall and the very short, extraordinary mental aptitude ought sometimes to occur."

ECHINOCYSTIS LOBATA.

This is an annual trailing plant, which will not find favor with those who love brightly colored flowers, but the elegance of its habit will commend it to others. It is a cucurbit native to the Northeastern States of America. The plant is nearly glabrous, with slender, angular stems, palmately lobed leaves, branching tendrils, and male flowers in branching panicles, the female flowers solitary, shortly stalked, from the same axil as the male flowers, and ripening into an ovoid greenish berry studded with small prickles. We are indebted to the Gardeners' Chronicle for the cut and copy.

RENEWING OLD TREES.

OLD trees are among the most cherished treasures of rural and suburban homes. They are the most costly, too, as every finished product is costly into which has entered those transforming and creative processes which only long reaches of time can furnish. An old house may fall down or be destroyed by fire, and while we mourn the loss of the visible sign of old associations, a better and more beautiful structure can be made to take its place. But when an old tree that has been the

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guardian of the home for generations, and stood there before the home was founded, surrenders to the blast, the loss is beyond repair, for a long time, at least. As there is no immediate remedy possible, the need of precaution becomes all the greater. When one of these old sentinels begins to show signs of disease and decay and year by year grows more attenuated in its branches and weaker in leaf growth and power, we watch it as we watch a friend attacked by a slow but incurable malady. But remedies are now being discovered for almost every ill of the body, and successful tree surgery is or may be as common as the higher form of that science. A recent number of *Garden and Forest* discusses the rejuvenescence of old trees, and gives practical directions for effecting it. Directly to the point are two illustrations of the same tree, a venerable oak in the Arnold arboretum. The first is of a tree with far reaching branches, but marked by infallible signs of decrepitude, the leafage scanty and the general prospect of life discouraging.

The second illustration shows the same tree twelve years later, shorter of limb, it is true, but displaying vigor in every leaf and fiber, and exhibiting every characteristic of youth and strength and hopeful promise of longevity. No miracle, not even one of Nature's, has been performed. The result is simply one of skillful tree surgery, of intelligent pruning according to the De Car's system, which, instead of sending the tree blood long distances through collapsed and withered arteries, contracts the area and applies the nourishing forces in such a way that they can be assimilated and made to promote the growth of all the members. The process is one which almost any intelligent farmer or tree owner should be able to apply. "Vigor can be restored to a tree in this condition by shortening all its branches by one-third or one-half their entire length. The only care needed in this operation is to cut back each main branch to a healthy lateral branch, which will serve to attract and elaborate by means of its leaves a sufficient flow of sap to insure the growth of the branch." These directions must be carefully observed to prevent further decay, and care must also be taken to leave the lowest limbs the longest, so that the greatest possible leaf surface shall be exposed to the light. So if some old tree, near roadside or dwelling, that has been the landmark of a century, shows alarming symptoms, the owner should not despair before he has treated it according to the general plan here laid down.—*Boston Transcript*.

TOBACCO IN GERMANY.

THE consumption of cigars is steadily increasing in Germany, whereas the use of the old clay or porcelain pipes is steadily decreasing. In the cigar manufactories of Baden alone 1,000 to 1,300 more workmen were engaged last year, and it is said at the same time that the goods stored in 1895 have also been disposed of; the demand at times was greater than the production. Through the increase of cigar factories, there is a growing stock of raw tobacco for pipes. But while the cigar is driving out the pipe of the German middle classes, the laborer and the peasant, on the other hand an enemy is arising for the cigar in the cigarette and short pipe, the use of which has been imported into Germany from England.

The consul-general at Frankfurt says that the German manufacturers of cigarettes look upon the constantly increasing use of foreign cigarettes in Germany with much uneasiness. The import, which in 1895 was only 44,900 kilogrammes (98,780 lb.), advanced to 161,800 kilogrammes (355,960 lb.) in 1896, and 171,700 kilogrammes (377,740 lb.) in the first eleven months of 1896. It surpasses the value of the German export of cigarettes already six times, and is at least half as large as the value of the cigarette manufacture in all Germany. France is sending large quantities of cigarettes each year, and the imports from Turkey, Greece, and Herzegovina are also increasing. It is stated that the importation of English smoking tobacco might be increased, and it is already slowly but steadily gaining ground. At Frankfurt a great deal of English tobacco is smoked, especially by the upper classes.

It is Consul Oppenheimer's opinion that English tobacco and pipe manufacturers might with advantage open business connections in many places in Germany. The wooden pipes which of late have almost entirely ousted clay and porcelain pipes are indeed manufactured a great deal in Germany, but they are finished in England, especially the better qualities (silver mounted), and these find a ready market.

Considerable attention has lately been given in Germany to innovations in the culture of tobacco. The tobacco plant has been known in Europe for three centuries, and during the same period its culture has been an annual one. The seed is sown in hot beds, brought to germination there, and when the young plants have grown somewhat, they are transplanted into open soil in order to be harvested when the valuable leaves have developed. This culture is based upon the idea that the tobacco is an annual plant and cannot outlive the winter, so that it must be sown annually, and be planted afresh every year. Now it is said that tobacco planters and botanists have been mistaken.

Wilhelm Daroezi, of Budapest, the editor of a Hungarian tobacco journal, has proved that tobacco is a perennial plant, which may be kept in full vigor for years, and that it then has fresh leaves every year. Should these leaves in the second year and later on prove of use for smoking material, this discovery will bring about the possibility of saving the tedious and expensive method of growing seedlings every second year or oftener, and doing away with their planting in the open fields, and thereby of reducing the cost of production of tobacco very considerably. Whether this will be applicable also to the German climate cannot yet be asserted without trial.

Two German tobacco manufacturers have also kept tobacco over winter as decorative plants, and one of them is even in possession of a plant aged seven years. Both are of opinion that these perennial plants only bring forth diminutive leaves, so that the value of plants kept over winter is but trifling, regarding them from the point of view of leaf tobacco.

M. Daroezi is of a different opinion in this respect. According to his views these small leaves are only a consequence of the unfavorable climate, perhaps the fault was also with the kind of plant which had been chosen to stand over the winter; at all events he says

that he obtained good useful leaves even in the second year's crop in Hungary.

Though in this respect the importance of the discovery may be doubtful for the culture of tobacco, the observers are so far unanimous on one important point, viz., as to the possibility of increasing the tobacco by seedlings from perennial plants. This observation is of the greatest importance; if it is possible by cutting the tobacco plant after the harvest to shield the roots against frost by covering them up, they will, at the beginning of spring, germinate again and furnish shoots which can be planted out. In this way it would be possible to shift the tobacco harvest in Germany into a more favorable season of the year. This may become of importance to the culture of tobacco in such a way that tobacco gathered and dried under more favorable temperature and conditions of humidity would probably be much better in quality than hitherto.—*Journal of the Society of Arts*.

THE GUIMET MUSEUM.

THE Guimet Museum, which was founded at Lyons eighteen years ago, and afterward ceded to the government, was, in 1888, transferred to Paris and installed in



FUNERAL MASKS FOUND IN THE EXCAVATIONS AT ANTINOE.

the vicinity of the Trocadero. This public museum, now classed among the national institutions, serves for diffusing information as to the civilizations of the East and for facilitating religious, artistic and historic studies by means of the images and sacred books and of the objects of worship and art that compose its magnificent collection.

We wish at present merely to call attention to a few of the novelties with which its already large collection has recently been enriched.

One entire hall is devoted to documents concerning Egypto-Roman worship. In the excavations made at Antinoe, a city founded in Egypt by Emperor Hadrian, and under the ruins of a granite temple that had been pointed out to M. Guimet, M. A. Gayet found half of a statue of a Roman Isis. Exploring, in addition, the ground comprised between the city and the Arabic



A PARSEE RELIGIOUS CEREMONY.

chain, the learned Egyptologist discovered the site of four cemeteries of different ages. Although the Egyptian, Byzantine and Coptic necropolises yielded up to him only objects of which museums already have specimens, the Roman necropolis, on the contrary, held a surprise in store for him. An entire humanity, an entire civilization, arose therefrom in the form of human remains, now draped in the Roman style and now clad in Asiatic robes. The fabric of these garments, which were Oriental silks woven by Syrians who were experts in combining shades, flowers and symbolical animals, are marvels of color and design. There were also fine women's leather shoes—real Cinderella slippers, stamped in gold with ornamental dies. The majority of the bodies had upon the face a plaster mask (see accompanying figure), pro-

vided with enamel eyes and constituting a true portrait. Among the finds we may mention a small convex mirror, not of metal, but of glass backed with mercury. For the history of science and industry, this is a very unexpected and important relic.

In hall No. 7, devoted to the religion of the Parsees or Guebres (adherents of fire and followers of Zoroaster), a very interesting number is a reconstruction of a religious ceremony. A large glass case incloses a group of four figures of natural size—two Mazdean priests and a young man and young woman. The officiating priest, who is of the Rasmic sect, is seated upon the floor with his legs crossed, and is placed in such a position as never to have his face turned toward the north.



CHINESE ARM CHAIR PROVIDED WITH SPIKES.

He wears the "pagri," a sort of high cap, which, like the rest of his costume, is white. His mouth is concealed behind a "padam," conformably to the doctrine of Zoroaster, which regards the saliva, breath, etc., as impure. The other priest, who has a long beard and stands to the left, belongs to the Kadimic sect. He is clad in an ample "jama," girded with the "pichori," and wears upon his head a sort of turban called a "phenta." The young man wears a tunic called a "doughly," and a pair of red silk trousers and a black "pagri." The costume of the maiden consists of a pale rose colored tunic called a "sari," a girdle ("kusti"), a head band ("mathabana") and a sacred chemise ("sudra"), an essential part of the Zoroastrian livery.

The metallic utensils, arranged upon the low table before which the priest sits to celebrate the office of

the Yaena (offerings to the sacred fire), are thirteen in number: The "mahrou," serving as a support for the "barsom," a bundle of date twigs; the "kavan," or mortar, in which the "haoma" is brayed; saucers, or "thaste," one of which contains a ring surrounded by a hair of the sacred bull; and vessels for the sacrificial fire, which must not be confounded with the sacred fire, which is always shut up, out of sight, at the back of the sanctuary.

The Guimet Museum alone owns a complete collection of such utensils, which, like the costumes of the figures just mentioned, are absolutely authentic.

Among the curiosities in one of the halls may be seen an arm chair from Amoy—a terrible instrument of voluntary torture, of which the seat, back, arms and foot rest are studded with sharp points. It ap-

pears that there are fanatics who allow themselves to be carried in this in processions, and, in addition, inflict upon their flesh numerous blows with a ball bristling with iron spikes.—L'Illustration.

THE UNIFICATION OF TIME.*

TIME reckoning, as at present conducted, presents curious anomalies. The civil day begins at midnight and ends at the following midnight. The nautical day begins at preceding noon and concludes at noon of civil day. The astronomical day begins at noon and ends at the following noon. It is therefore apparent that any given date extends over, or into, three different days. Many navigators, however, for many years past, have for convenience kept civil time at sea, re-dating their logbooks from midnight. A movement to reform time reckoning had its origin on the American continent, from the circumstance that the embarrassment of many independent reckonings had been most powerfully felt in the United States and Canada, those lands of magnificent distances, and that hold within themselves and between their bounding oceans so many degrees of longitude. It is stated in the last report of the Royal Society of Canada dealing with this subject that so late as 15 years ago there were between the Atlantic and Pacific no less than 70 different standards of time referred to in the working of the different railways quite unrelated to and independent of each other. It would necessarily result that as steam and electricity would open the continents of Asia, Australia, and Africa, not to mention the continent of Europe, the difficulties felt on this continent would be further extended.

The movement to effect a reform in the time reckoning of all nations took its origin in Canada in 1876, and therefore as to age it has attained its majority, but not yet its entire fruition. The Canadian Institute was probably the first scientific society in any part of the world to give the subject earnest consideration. At the meetings of this society held in February, 1879, the reckoning of time and the establishment of a prime meridian as a general time zero to be common to all nations was fully discussed. In May and July, 1879, and in May, 1880, the Governor General of Canada brought the views promulgated by the Canadian Institute to the notice of the imperial government, and through the imperial government the attention of foreign powers and scientific societies in all parts of Europe was directed to them. At a meeting of the American Society of Civil Engineers held in Montreal in 1881, Mr. Sandford Fleming (now Sir Sandford Fleming), a Canadian member thereof, led a discussion in formulating certain principles as to reckoning and unification of time.

An active interest in the subject was awakened among the members of this society, many of whom were intimately associated with the great railways of America. An important outcome was the general adoption, a few years afterward, of the system of standard time by which the confusing multiplicity of standards, previously in use, were abolished, and the reckoning by the meridian of Greenwich as the prime standard throughout the United States and Canada. In this consummation the American Meteorological Society heartily co-operated. The Canadian Institute and the last named society sent Mr. Fleming to Venice to attend the International Geographical Congress held in September, 1881; his special mission was to advocate the establishment of a first or prime meridian to be common to all nations as a time zero. The United States and Canadian delegates, among other things, suggested that an international conference should be specially convened to determine upon such a zero meridian, and proposed that such a conference should be held at Washington. The Congress of the United States thereafter, with a view to the principle of uniformity and simplicity of time, passed a resolution in the direction of obtaining an international agreement regarding time reckoning, and thus sought to minimize the difficulties arising from the confusion that then prevailed, and which still, to some extent, continues to prevail. The representatives of 25 nations, as well as the Canadian representative named above, met in Washington in 1884, at the invitation of the President of the United States, and after a conference extending over a month passed seven resolutions, the first five of which have been practically and generally accepted by the civilized world. The observations which follow have a special bearing upon the sixth resolution of that remarkable conference, which was carried unanimously, and is as follows: "That the conference expresses the hope that as soon as may be practicable the astronomical and nautical days will be arranged everywhere to begin at mean midnight."

It is also evident that as the nations which publish ephemerides prepare them four or five years in advance, and as it is important that any date upon which the new era shall commence be one easily remembered by astronomers and computers or navigators, a common understanding should not be delayed beyond the first year of the coming century or 1901.

The question of time reform remained in this position until the year 1893, when the Astronomical and Physical Society of Toronto, in co-operation with the Canadian Institute, appointed a joint committee, with Sandford Fleming as chairman, to suggest the best means of ascertaining the views of astronomers throughout the world. This committee accordingly, upon April 30, 1893, addressed by circular letter the following question to astronomers and other scientific men throughout the world:

"Is it desirable, for all interests concerned, that on and after January 1, 1901, the astronomical day should everywhere begin at mean midnight?"

The replies received were in number 171, of which 108 were favorable to the change and 63 unfavorable. Many of the former are strongly and earnestly in favor of the adoption of the civil day for astronomical purposes, while the writers of some of the latter seem to have been under a misapprehension. They object to the adoption of the civil day on the ground that its division into two series of 12 hours, designated A. M. and P. M., would be inconvenient for astronomers. It is obvious that this objection has no weight, as the 24 hour notation would remain associated with astronomical

reckonings as at present; moreover, indications are not wanting that the astronomical practice of counting the hours in a single series from 1 to 24 will gradually win its way into general favor in civil life. The 24 hour notation has already been introduced into use over wide districts in Canada, in several European nations, and throughout the Indian empire; and there is a movement in Europe, in Australia, as well as in the United States of America, especially among railway men, to bring this mode of reckoning the hours into general use.

In classifying the replies from astronomers according to the countries from which they have been received, the votes for or against the change stand as follows:

In Favor of the Change.

Austria	Australia	Belgium
Canada	Colombia	England
France	Greece	Italy
Ireland	Jamaica	Madagascar
Mexico	Roumania	Russia
Scotland	Spain	United States

Unfavorable to the Change.

Germany	Holland
Norway	Portugal

Classifying these results according to the shipping of the different countries represented, we find that those favoring the change represent 85 per cent. of the tonnage of the world's marine. This fact has an important bearing upon the whole question when the convenience of the navigators, with whom the "Nautical Almanac" is a *vide meum*, is considered.

This report was communicated to His Excellency the Governor-General, for transmission to the British government, by whom it was finally referred to the Admiralty. The Lords Commissioners of the Admiralty, under whose supervision the "Nautical Almanac" is published, expressed their willingness to sanction such alterations as may be necessary to effect the change at the beginning of the new century, provided other nations who publish astronomical ephemerides are prepared to take the same action. The British government thereupon instructed Her Majesty's representatives to ascertain the views of the foreign governments to which each was accredited, with regard to the proposed change. Of these nine powers, six have formally given their assent to the proposed change.

The six nations formally assenting to the adoption of the recommendation of the Washington Conference on January 1, 1901, are Austria, Brazil, France, Great Britain, Mexico and Spain. Of the remaining three, Germany and Portugal have not, so far as is known, sent any reply. A brief communication has been received from the Secretary of State at Washington, simply stating that "the members of the United States Naval Observatory are adverse to the 'Canadian proposition,' as they term it, and, at the same time, he sends a copy of the adverse report, signed by these three members."

This is the only report from astronomers and observatories the world round which is of a negative character, and it is the more extraordinary as it also negatives the position taken by the United States from the inception of the movement to reform time reckoning. That country has been in the very forefront of the project; it has, in fact, borne its standard and spread its banner. Its government, its learned societies, its scientists, its practical men, its railway managers, its people, have been at the very cradle of time reform, have carefully watched its adolescence, have rejoiced at its coming vigor; but now in its twenty-first year the Washington Secretary of State has been advised to refuse its adoption. Verily, this child of the Washington conference, introduced into public notice in 1884, by five distinguished delegates as nominated by the United States government, and hailed with the acclaim of 25 nations and Canada, constituting that conference, has had that mark of paternal preference, the coat of many colors, torn from him, and he stands denuded, if not, indeed, wounded, in the house of his own friends.

So far these remarks have dealt with the efforts made by the Canadian societies for the unification of the astronomical and civil day, but the proposition of the Washington conference went further. It sought to bring also into harmony with these two a third discordant note, that of the nautical day. But thus far it has been, only historically but not effectively, a voice—*vox sed preterea nihil*. It is comparatively easy to obtain opinions of astronomers, as they are for the most part attached to observatories or their addresses are known; but navigators pursue their calling under such different circumstances, being either at sea or for a very short time in port, and then being much occupied with the active duties of their profession. It, however, by no means follows that shipmasters are indifferent to this subject, which so much concerns their business and convenience. In order to reach the opinions of British and foreign shipmasters on this subject, communication was opened by the Astronomical and Physical Society of Toronto, with Mr. W. Nelson Greenwood, F. Imp. Inst., of Lancaster, England, the compiler and publisher of certain *kludonometric* or tide tables issued at Manchester, England. The result was that Capt. Greenwood propounded the following questions to shipmasters:

1. Are you in favor of the Greenwich meridian being universally recognized as the prime or first meridian by all?
2. Are you in favor of the unification of time as reckoned from such prime meridian and extended to all nations irrespectively?
3. Are you in favor of the unification of time as applied to the civil, nautical and astronomical days; and is it desirable in the interests of all concerned that such days should commence at mean midnight?
4. Are you in favor of reckoning the days by the 24 hours' system, counting the hours for each civil, nautical and astronomical day from mean midnight throughout the 24 hours to midnight again? This will do away with the old A. M. and P. M., but will make mean noon the twelfth hour for all three systems of time reckoning alike.

As question 3 affects more directly the subject bearing of this paper, I confine myself to that.

The result was that, up to July 25, 1896, 409 shipmasters from steam vessels and sailing vessels, both British and foreign, were heard from, and of these 399

answered "Yes" and 10 answered "No" to above question 3. Of these, 363 were masters in active service, representing a total tonnage of 455,810.

There would, therefore, appear a very large amount of unanimity throughout the nations of the world for the proposed changes, but yet there was not absolute unanimity; and to the communication from the joint committee of the Canadian Institute and the Astronomical and Physical Society of Toronto forwarded through the office of His Excellency the Governor General to the Lords Commissioners of the Admiralty, a reply was received in December, 1896, that inasmuch as unanimity in the effort to make the desired change on the part of other nations that published ephemerides had not been obtained, their lordships had no intention of moving in the matter.

In many most important matters involving the welfare or convenience of mankind and in which consent is necessary, a minority—even a small minority—exercises a controlling power. This is one of these matters. But it has not been allowed to rest. The importance of the subject demanded further movement, and that movement in the straight line of a more widespread knowledge and of a continued and (if possible) a clearer presentation of the advantages of the proposed reform.

At the last meeting of the American Society of Civil Engineers, in June, 1897, a resolution was formed authorizing and requesting the board of directors of the society to take such steps as they may deem advisable to move the United States government to finally adopt the sixth resolution of the Washington Conference in 1884.

It is expected that the American Meteorological and other societies in the United States will take similar action. On June 25, 1897, the Royal Society of Canada, at its meeting in Halifax, Nova Scotia, passed the following resolution:

"That as there is a reasonable prospect of the United States accepting the recommendations set forth in the sixth resolution of the Washington Prime Meridian Conference of 1884, the council be authorized and requested to take such further means as may seem best calculated to secure unity of time reckoning at sea as on land; and with that view a special request be made to the British Association, when it meets in Toronto, to co-operate with the Royal Society and other Canadian societies in influencing Her Majesty's government to adopt the proposed change on the first day of the new century, and to make such alterations as may be necessary on the 'Nautical Almanac' as soon as practicable."

The question of the unification of time is not a new one. In fact, it offers an illustration, on the one hand, of the apothegm that "there is no new thing under the sun," and, on the other hand, furnishes an example of that philosophy which teaches that "the thoughts of men are widened with the process of the suns."

Hipparchus, "the father of astronomy," himself counted the hours from midnight to midnight. He found no difficulty in commencing an observation on one day before 12 at night, and ending it the next day after the same 12 at night. Some modern astronomers, it is said, find this is an insuperable obstacle. They might forget to note the change from one day to another. Ptolemy introduced many errors into science, which the world for many centuries believed were truth, and among his errors introduced the practice of taking noon as the moment from which the hours were to be counted. The present astronomical day is then a relic of the Ptolemaic system. The rest of this false philosophy has long ago disappeared. This part, the only part, still survives. It does not, however, survive because it is the fittest, but because it is not the fittest—upon the *Lucas* a non lucendo principle. And so it remained until in 1804 La Place sent to Le Bureau des Longitudes a letter in which he proposed to unify astronomical time with civil time by counting the hours from midnight, which proposal they adopted. Nevertheless, *La Connaissance de Temps* continued, and still continues, to appear in the Ptolemaic method of counting astronomical time. La Place, however, who possessed the instincts of a genuine reformer, in *La Mécanique Céleste* and in the calculation of his tables employed civil time; and in this was imitated by the other French constructors of tables until Le Verrier put on the old garments of a non-scientific conservatism, and started his day at high noon. After the Washington and Geneva conferences and with their discussions before him, M. Faye, the French astronomer, was reminded that the bureau had, under the influence of La Place, formerly calculated the lunar and planetary tables for Paris mean midnight, but no change was made.

The bureau was consulted in 1894 by the Minister of Public Instruction for France, and on October 19 in that year reported in favor "of the principle of the reform set forth in the sixth resolution of the Washington conference, and advocated by various societies in Canada and in the United States," and favored the adoption in practice, provided that the countries publishing the most important ephemerides took concerted action. The bureau, moreover, took a step further in a most important direction. It officially expressed to the Minister of Public Instruction the decided opinion that unification would not be complete until the civil day should be reckoned, as in Italy and in other countries mentioned, in one series of hours from 0 to 24, and so do away with the old notation of A. M. and P. M. This further reform has been already legalized by an act of the Province of Ontario, 58 Vic., Cap. ii, being "The Definition of Time Act, 1895," which provided that the time referred to in any act of legislature, by law, deed, or other legal instrument, be held to be standard time; and as regards that part of the province lying east of the meridian 87° west longitude, standard time shall be reckoned as five hours behind Greenwich time; and as regards that part of the province which lies west of the said meridian, standard time be reckoned as six hours behind Greenwich time.

And it was further enacted that the hours of the day and night in any locality be numbered in one series up to 24, according to the "24 hour notation" so called. So that in respect to time reform, the Province of Ontario has been doing all she can to stand in the foremost rank. This reform has the support of the highest authority.

Sir John Herschell writes: "Uniformity in nomenclature and modes of reckoning in all matters relating

* By John A. Paterson, M. A., President of the Astronomical and Physical Society of Toronto. Paper read before the British Association, Toronto meeting.

to time, place, weight, measure, etc., is of such vast and paramount importance in every relation of life as to outweigh every consideration of technical convenience and custom."

Mr. Christie, the English astronomer royal, among many other potent reasons in support of the change as affecting astronomy, points out that for spectroscopic and photographic observations of the sun, the day is reckoned from midnight, and the same reckoning would naturally be used by the observer for spectroscopic and photographic observations at night and also in determinations of the places of comets, stars, etc., which he may take in connection with his spectroscopic observations. It would seem passing strange to expect the same observer to change his system of reckoning mean solar time according to the class of observations he is making at the moment. Commodore Franklin, Superintendent of United States Naval Observatory, Washington, in December, 1884, just after the Washington conference, wrote a strong argument in support of the change, and remarked: "It seems to be eminently proper that the nation which called the conference should be among the first to adopt its recommendations."

These deponents are called at random from a great cloud of witnesses and testify accordingly. For the sake of brevity, I do not call to the witness stand Cleveland Abbe, Burkhalter, Comstock, J. E. Gore Hadden, Garrett P. Serviss, Captain Abney, Lewis Swift, Trouvelot, Dr. Max Wolf, and a host of others. But what are the objections urged in opposition to the adoption of this reform? It is said that for a time confusion would prevail at sea. The evident answer to this is the testimony of navigators themselves, as has been above set forth by Captain W. N. Greenwood. These men who stand on the quarter deck and handle the sextant and the "Nautical Almanac" know whereof they speak, and they have not spoken in ambiguous voices, but loudly and definitely. Are we to hear and to give effect to their evidence, or are we to listen to others who live ashore and think they know better? To this there can be only one answer. The other objection to the change is that it would be inconvenient for astronomers and computers. No doubt the change from the Julian to the Gregorian calendar was an inconvenience, and if that objection had prevailed about the year 1582, and continued to prevail, we would have been now still groping along in the dark and devious ways that Cæsar projected. Whose convenience is to be consulted, that of the astronomer or that of the navigator? The astronomer and the computer are not pre-eminent, and their "Nautical Almanac" is not the end. All these are only means to the end, and that end, in so far as this subject matter reaches, is to facilitate the work of the navigator and to perfect the art of navigation. The navigator was not made for the astronomer, but the nautical astronomer for the navigator. There is confusion now, for in various official publications some portions are given in astronomical time and other portions in civil time; but let this reform be inaugurated, and straightway for the future the wrinkles and creases are smoothed out, and harmony reigns, and the sooner the better, so that the masses of incongruity may not further accumulate.

But it may be said that this reform cannot be made practicable in the year 1901, inasmuch as the ephemerides for that year are now published. That circumstance, however, in no respect affects the principle involved in the question. The wisdom of the reform being established, then the date of its inception is a mere matter of detail and may be left for some mutual agreement to be come to among governments interested. If we once get down to the base rock of the principle of uniformity, then it is a matter of certainty that its inauguration will follow very rapidly. At the same time there is a peculiar fitness in having the resolution of the Washington conference carried out literally, that is, on the first day of January, 1901, and that matter could no doubt be accomplished by publishing a supplement to any ephemerides already published for that year.

All reforms have to overcome a certain callousness of custom before they can be accommodated to the various convolutions and angularities of opinion and convenience. Much deliquescence of dogmatism must result before the current of reform shall run smoothly over the rocks of conservatism and mingle with the broad and ever broadening ocean of knowledge, and thus add a fresh sparkle to the face and form of rainbow-vestured truth.

Our feet almost touch the threshold of the twentieth century, our hands are almost on the latch that opens to us new history. Centralizing, harmonizing and unifying are strongly impressive on the spirit of the times. The ages grow from more to more and old orders change. More facilities, more centralization, more uniformity, more cutting off the rough and raveled ends of merely old customs, old methods, and old forms crowd round about us. Old landmarks shift; like old scaffolding, they are no longer useful; they only mar the outlook of progress, and with many other curious anomalies let this one vanish and a new era of time reform brighten the coming century.

These observations are respectfully, but confidently, submitted with the hope that the British Association for the Advancement of Science will lend its aid in bringing this important subject before the nations of the world for final consideration.

THE OBSERVATION OF METEORS, WITH ESPECIAL REFERENCE TO THE LEONIDS.

DURING the next few years a large amount of attention will be given to meteoric astronomy in general and to the great shower of Leonids in particular. The present may, therefore, be an appropriate time to refer to a few points connected with this interesting branch. It has often occurred to the writer that it would greatly facilitate the comparison of different materials if observers adopted one uniform method of recording meteor flights. Some merely give estimated compass bearings, and a rough guess at the altitude and inclination of path, others give the place and direction according to conspicuous stars near, others simply mark the courses on a map without reading off the individual positions, while others give the R. A. and Decl. of both beginning and ending of every object observed. It would be a great advantage if every one tabulated re-

sults according to the latter method. It can easily be done if the tracks, as observed, are penciled upon a celestial globe or star chart, and the positions read off; and this is a much more exact method than describing the flights by stars near which they happen to pass.

Another point is that the accurate observation of meteors demands a considerable amount of practice. It would, therefore, be a most useful preparation for intending observers of the Leonids if they carefully watched the Perseids of August, Orionids of October, and some other prominent displays, and gained a little practical experience of the work. They would find it of material assistance to them, and it would enable the Leonids to be observed more expeditiously and correctly than must otherwise be the case. Accounts are sometimes published of meteoric showers by persons who are reporting a perfectly novel experience, and it is not too much to say that such descriptions are useless as regards many essential details. A perfect novice may of course stand and count the number of meteors visible, and may be capable of describing a star shower in a general way, but he is heavily handicapped when it comes to recording the more difficult features with precision.

What photography may achieve in meteoric work we cannot definitely foresee, but it is quite certain that the proper observation of meteors, as at present conducted, demands the work of a lifetime. A man must watch for meteors all night, and suitably record them, and by day he must analyze the observations and determine the radiant points. The observer need not, perhaps, absolutely isolate himself from all other work; but the meteoric branch is such an extremely difficult one, embracing, as it does, some thousands of streams which exhibit many different peculiarities, that in order to grapple with the subject successfully he must make it his constant care and the object of his earnest efforts and thoughts during many years.

Fortunately the Leonids are to be classed among that description of meteors comparatively easy to observe and record. They leave streaks for a second or two, and from these the directions are to be determined with great facility and precision. It is also a fortunate circumstance that the radiant point is surrounded by the well known stars in the Sickle of Leo. The lines of flight may therefore be readily carried back in the correct directions by projecting a straight wand upon the streaks, and noting their points of convergence relatively to the stars named.

The writer has usually found the radiant very definitely and sharply defined, and it can be readily fixed to within 2° of probable error. But naked eye observation is capable of much more accurate results than this, if, during a pretty active return of the shower, the observer will independently fix the radiant during, say, successive half hours of the night; he will in this way get eight, ten, or twelve positions, from which he may derive the mean place of the radiant to within about ½° of error.

The Leonid radiant is sometimes described as very diffuse; but this is a false effect brought about by two circumstances which, if properly allowed for, would leave a very definite and satisfactory position. One cause of its apparent diffusion is that meteors are attributed to it which really belong to the minor showers in Leo and the surrounding region, of which quite a large number exist. They display similar visible characteristics to the Leonids, and can only be dissociated from them by the exercise of extreme care in noting their directions of flight. In Popular Astronomy, vol. i, p. 298, I gave a list of sixty-eight meteoric radiants situated in various parts of the heavens, and active during the period November 10-15; and in the Observatory, vol. xx, p. 306, a table of seventy-two Leonid showers was published. Those which chiefly affect the determination of the Leonid radiant are placed near δ and ϵ Cancri, μ and ϵ Ursæ Majoris, λ Hydræ and α , λ , τ and β Leonis. The meteors are swift and usually leave streaks. Another contributing feature to dispersed radiation is found in the unavoidable errors of observation. Great care and habitual practice can, however, reduce these to small limits, and it will be found that the radiants derived from accurate materials will be pretty sharply defined.

The probable error in the case of different observers must, however, vary to a considerable degree, for practice cannot equally eliminate inaccuracy from among them all. In catching and retaining correct impressions of meteor flights, natural aptitude exercises an important influence. It is like a game of skill depending upon the eye, judgment and quickness in execution. Really few will excel, while many will only attain mediocrity, and some must altogether fail to acquire the desirable proficiency, even after years of experience.

The horary rate of appearance of Leonids cannot be exactly determined unless the contemporary showers are considered, and their meteors separated from the true Leonids. Many observers count every meteor proceeding from the general direction of Leo as necessarily a Leonid, and thus the horary number is exaggerated. If an inexperienced observer gives 20 as the number of Leonids seen in an hour, the fair inference is that not more than 14 or 15 of them were true members of that system. During very strong returns of the shower this point may, however, be disregarded, for the minor streams can then exercise very little relative influence on the results, and are virtually obliterated by the superabundance of Leonids.

One new feature to be attempted during the ensuing return of the Leonids is to photograph the meteor group of November, 1866, in space, and an excellent ephemeris of its nearly stationary position in Libra and southeastern limits of Virgo, during the first four months of 1897, was given in Monthly Notices, lvii, p. 70-2. Some people will regard the idea as little more feasible than opening a correspondence with the inhabitants of Mars, and certainly there appears very slender prospect of its successful realization. The experiment ought, however, to be tried. Let us support every project which has a possible side to it, for it is quite clear that many things deemed beyond our reach are capable of attainment by persevering efforts and proper means. Novel attempts of this kind, if seemingly chimerical, should not be hastily condemned or necessarily considered as vain labor. Mr. Roberts' photographic search for a transneptunian planet was a novelty, and it proved vain labor; but who will say that it ought not to have been undertaken? The same may

be said of Mr. Barnard's similar search for a satellite to the moon. To look for a fifth satellite of Jupiter was decidedly a novelty in these modern times, and yet it proved productive. Let, then, new researches like these have our encouragement; for if they do not always succeed, they stimulate our interest and enthusiasm, and make the science more attractive by imparting to it a welcome freshness and, perhaps, a touch of romance.

As to the practical aspect of the question, it is fair to conclude that the Leonid group of 1866 is too faint an object to be ever impressed on a photographic plate, especially when its distance is so great as during the past spring, for on March 1 this was equivalent to 800,000,000 miles, and not far short of the mean distance of Saturn! In the great meteor storm of November 27, 1885, when the meteors were more thickly congregated than in the Leonid shower of November 13, 1866, Prof. Newton computed that "the space in the meteoroid group corresponding to each single, visible meteor was in the densest portion of the group a cube whose edge is 32.8 kilometers, or 20.4 miles." This means one small pebble in twenty miles of space! The degree of illuminating power exhibited by a group of these bodies, separated by such distances, must be infinitesimally small. If any one were to attempt to photograph Tempel's comet (1866 I), on its return journey, the chances of success would be far greater, for though the comet has still to run eighteen months before reaching perihelion, it is nearer to us than the meteor group of 1866, and must be infinitely brighter, as it doubtless represents the richest part of the stream. We must remember that Tempel's comet passed its perihelion on January 11, 1866, while the meteor group reached it ten months afterward; and it is quite fair to suppose that the meteoric train of the comet, at a distance of some hundreds of millions of miles from the nucleus, must be relatively tenuous as compared with that part in the immediate wake of the comet. The meteors may not, however, show a regular decrease in numbers according to distances from their derivative comet, but may probably consist of a series of groups. There is every reason to believe that disruptions of a violent character affect the physical character of comets, and this was well exemplified in Brooks' comet (1899 V), visible, in 1896, at its second observed return, which was seen separated into five portions on August 1, 1899. There is, however, every probability that the meteor cluster of 1866 is some hundreds of times fainter than Tempel's comet; yet even the latter was not visible to the naked eye in December, 1865, or January, 1866, and indeed the object was only followed for a month in telescopes. It might be a good plan to endeavor to photograph the comet first, and then fish for its associated meteor stream; for the easier objects are sometimes capable of leading us up to the discovery of the more difficult ones.—W. F. Denning, in Nature.

THE AMERICAN LOBSTER.

PERHAPS no other inhabitant of the ocean so important from a commercial point of view as the lobster has been so thoroughly neglected by the naturalist, says Self-Culture. History and literature, from old Grecian days up to the present, abound in references to this curious creature; but it was not until there was an industrial demand for information in regard to artificial rearing that science really turned her attention lobsterward.

But two species of the lobster are known to the economic world, the European (*Homarus vulgaris*) and the American (*Homarus americanus*). To the latter species we will confine our remarks, as the most interesting as well as the larger of the two.

While it is difficult to determine boundary lines of marine products, it is safe to say that a belt from thirty to fifty miles wide, and extending from a little above the Straits of Belle Isle to Delaware, would include practically every American lobster in existence. Indeed, this territory includes much barren ground, some parts being too deep, others too shallow. Almost any depth from one to a hundred fathoms is deemed promising, but the favorite territory is much more restricted. The largest lobsters are found toward the north of this belt—a fact which some consider accounted for by the northern grounds being the most recently fished from, and therefore less culled over.

One hardly expects to find in the lower orders a species of intelligence comparable in interest with that of higher animals. We rather hope to be entertained by some novel substitute which nature may have provided for intelligence. One interesting accomplishment of the lobster is its ability when frightened to project itself, with almost incredible speed, a distance of twenty or thirty feet directly into its hole, no larger round than its body. When feeding it walks about quite briskly on the ocean bottom, which it seldom leaves from choice. Occasionally one can be dragged to the surface by thrusting an oar or pole into the burrow and then withdrawing it hastily as soon as the inhabitant has seized the offending stick in its strong claws. Usually, however, this method only brings the lobster as far as the mouth of its burrow, where it sagely releases its hold. In aquariums each lobster soon finds its individual retreat among the rocks with which the bottom should be provided, and which it invariably retains and defends against all intrusion.

As warm weather approaches, usually during April or May, there is a noticeable movement of the lobster kingdom shoreward, into water but a few fathoms deep. Late in the fall a corresponding inclination toward deep water occurs. The winter fishing is therefore in twenty-five or thirty fathoms of deeper water than the summer. The time of these movements is very largely governed by the forwardness of the season. Lobsters are very sensitive both to cold and light, their bodies being accustomed to the comparatively steady temperature and the obscure light of the ocean bottom. Exposure in captivity to strong sunlight is in a short while fatal to them.

Popular literature has more than once accredited to the lobster mother the same careful attention to her young that the crayfish gives. As a matter of fact, they receive neither care nor attention from her. As soon as hatched they at once scatter and shift for themselves. The hatching is from May to August, the average date varying somewhat with the location and the temperature or climate. When first hatched the

young lobster is less than half an inch long and in its habits totally different from the adult. The first few weeks of its life are spent at or near the surface swimming about, and it is not until after the fifth or sixth moult that it sinks to the bottom, even then less than an inch in length. At this period of its life the lobster is still shrouded in mystery, his long journey to the ocean bottom completely removing him from observation. Until four or five inches long they are too small to be held in the lobster traps, and too nimble to be approached direct. Sometimes specimens two or three inches long are found under stones near the coast, but from the time they sink into the ocean up to this period they are rarely found.

Perhaps at no period of its life is the pugnacious disposition of the lobster more apparent than during the first few days after hatching. Cannibalism, always a characteristic of the species, now asserts itself to a surprising degree and renders it practically impossible to raise young lobsters in an aquarium. Occasionally one of these youngsters will be found feigning death on being meddled with, but this is too uncommon to be regarded as a characteristic even of the young, and is never met with in adults.

In the matter of food the young lobster does not appear to be very discriminating, and seizes upon almost anything of available size with equal avidity. In its mature state the flesh of fish and other inhabitants of the deep is the favorite dish, and it does not seem very particular as to whether this is fresh or not. The bodies of dead fish are seized very greedily. Occasionally vegetable matter appears to furnish a part of their supply. Weak or injured lobsters, too, are the almost certain prey of their stronger and healthier companions. The food is seized and crushed by the heavy claws before entering the mouth. These claws, its dreaded weapons of defense, in the larger specimens frequently comprise more than half of the entire weight and a length seemingly out of all proportion to the remainder of the body. One monster, captured in the Penobscot Bay, Maine, weighing a little more than twenty-three pounds and measuring twenty inches, bore a crushing claw nearly fourteen inches long and more than sixteen inches in circumference. This lobster, it is estimated, could with ease have crushed the wrist of a man.

A most interesting means of defense, or rather of escape, is possessed by the lobster: that is its power, on demand, to cast off an imprisoned limb and reproduce a new member in a few weeks, the greatest inconvenience apparently to the lobster being its increased susceptibility to attack.

The use of the lobster is too well understood to need mention here, and its preparation for market is hardly within the province of the naturalist. Briefly, it may be said that lobsters are baited with dead fish in slat boxes with funnel-shaped entrances at each end. These are lowered to the ocean bottom and from time to time raised and examined. Once fairly caught, a full-grown lobster very seldom regains his liberty. This method, primitive as it may seem, is effectual enough; so much so that year by year the numbers of the lobster and the range of his camping grounds are gradually diminishing. While statistics show rather an increase than a diminution of the number caught, it must be remembered that this is through a constantly enlarging army of fishermen and traps, and is not due to the supply of lobsters. At the same time, as the old warriors of the deep are caught and give place to a newer generation, the weight of the catch is seriously diminished, even though the number is increased. The decline in pounds in the catch between 1887, when 28,882,188, valued at \$799,717, were landed in the United States, and that of the previous year was more than 5,000,000 pounds, while the market value was over \$260,000 more in the year 1886. More than 200,000 traps were, in 1892, operated, and over \$600,000 was invested in the various branches of the business. The importance, then, of protecting the lobster and preserving the industry to future generations is easily seen, while the wholesale destruction to which it is now subjected is a matter for universal regret.

WILDER GRAHAME.

ACETYLENE AS A QUANTITATIVE REAGENT.

ACETYLENE may be employed for the determination of copper. The salt to be analyzed is dissolved in 100 to 200 times its volume of water mixed with a few cubic centimeters of ammonia and heated for a short time on the water bath. Acetylene is then introduced into the dark blue fluid to saturation. The precipitate is complete even in the cold, but it takes place more quickly, and is better aggregated on warming, while at ordinary temperatures a portion often adheres obstinately to the sides of the vessel. In a closed flask the precipitate can be preserved for any length of time without decomposition; in an open vessel a part of the precipitate is again dissolved as long as the fluid remains alkaline. The copper acetylide is now collected, washed and decomposed by being digested for half an hour with hot diluted nitric acid, filtered from the carbonaceous residue and the filtrate evaporated to dryness and ignited. The ash of the filter and residue is also taken and the whole weighed as CuO . This separate ignition of filtrate and insoluble residue is advisable to prevent explosion. A too large excess of acid must be avoided. The acid contained in the original copper salt can easily be detected in the filtrate from the acetylene precipitate. For the separation of zinc and copper, as salts of the former metal are not decomposed by acetylene, the method is most useful. In the presence of excess of sulphurous acid the whole of the copper is precipitated by acetylene in a mixture of a solution of salts of the two metals. In an experiment with a known quantity of zinc, it was found that none was carried down by the copper acetylide precipitate.—Pharm. Centralh., xxxviii, 426.

A table has been made of all the degrees which have been granted by Cornell University. The total is 4,304, of forty-seven distinct kinds. Only two granted in 1886 are honorary degrees. These are LL.Ds. It is significant of the great growth of Cornell and its greater present importance in the educational world, that 3,014, or 70 per cent. of the 4,304 degrees, have been granted in the last ten years.

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